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AN EVALUATION MODEL FOR THE NATIONAL CERTIFICATION PROGRAM FOR MEDICAL LABORATORY TECHNOLOGISTS IN CANADA

by

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DOROTHY MAE RYAN

A THESIS
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Evaluation Model for the National Certification Program for Medical Laboratory Technologists in Canada", submitted by Dorothy Mae Ryan in partial fulfilment of the requirements for the degree of Master of Education in Vocational Education.

K. Puffer

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DATE April 16th, 1985

ABSTRACT

This study was proposed to establish an acceptable evaluation model for the national certification program in medical laboratory technology in Canada. This program, under the auspices of the Canadian Society of Laboratory Technologists (C.S.L.T.), has been in existence for nearly fifty years but has never undergone a formalized evaluation process. With the tremendous advancements continually being made in the fields of medicine, science and technology, the C.S.L.T. recognized an urgent call to evaluate its program in the light of the needs of the graduate and the prospective employer.

A detailed review of the various models of program evaluation and evaluation instruments was conducted. From this review, a comprehensive evaluation model was formulated and designed. This model accounted for all components of the program through the survey of the heads of training programs in Canada (antecedents), the extensive review of the accreditation system in Canada (process), and the design of two questionnaires, a follow-up and an employer survey (product).

To ensure the validity and reliability of the follow-up and employer questionnaires, an extensive pretesting procedure was developed and administered.

In addition, "dummy" tables and graphs were set up to indicate how the returned data should be presented.

The final chapter contains a number of significant recommendations to assist the C.S.L.T. in revising/ restructuring its certification program and Syllabus of Studies. It also outlines a number of future studies that should be considered in conjunction with these revisions.

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It is impossible to recognize adequately the support and contributions made by individuals and groups during the course of this study. However, the author would like to express her sincere appreciation to:

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CHAPTER ONE

INTRODUCTION

Evaluation of curricula and programs is rapidly emerging as a discipline in its own right and as a special area in the field of education. An increasing dissatisfaction with the limited results that the educational system seems to achieve has led to a demand for accountability and for reliable evidence of returns on societal investment by legislators and taxpayers.

At the same time, professional organizations involved in licensing/certification have recognized a similar need for accountability - not in response to educational systems, governments and taxpayers - but in response to very real obligations to the membership of the organization, the prospective employer, and the ever-changing needs of the growing fields of science, technology and medicine.

The Canadian Society of Laboratory Technologists (C.S.L.T.), cognizant of its vital role as part of the health care team, is one of the first nationally recognized health occupations in Canada to actively pursue this universal call for accountability through program evaluation.

This study represents the efforts to establish an acceptable model for program evaluation within the medical profession in general and within medical laboratory technology in particular. At the same time, it is recognized that the resultant model is not restrictive in its application and could be used as an evaluation model in any professional/technical program.

STATEMENT OF THE PROBLEM

The Canadian Society of Laboratory Technologists (C.S.L.T.) is the official registry and certifying body for medical laboratory technologists in Canada.

An individual proceeding to certification with the C.S.L.T. must successfully complete an accredited training program based on the approved Syllabus of Studies (guidelines to certification). This Syllabus of Studies is revised periodically in response to the changing needs of the scientific, technological, and medical fields.

Since its inception nearly fifty years ago, this certification program has never undergone an extensive evaluation process. In addition, it is recognized that the Syllabus of Studies represents the **PERCEIVED NEEDS** of the student technologists (needs usually perceived by educators) without sufficient documented proof that these are the **ACTUAL NEEDS** of the new graduate and/or employer. Each Syllabus revision involves numerous expansions and additions without a corresponding number of deletions to the actual core content required for certification. This situation cannot continue without adverse effects to the student, to the existing training programs and to the national certification process itself.

Therefore, the basic problem to be considered in this study is the development of an appropriate procedure or model for the evaluation of the existing national certification program for medical laboratory technologists in Canada with special emphasis on the validity of the existing Syllabus of Studies. In this way, it can be determined if this program is meeting the actual needs of the medical profession, teaching institutions, employers, society as a whole and the new graduates in the field.

PURPOSE OF THE STUDY

The purpose of the study is to review the various models and strategies of program evaluation generally used in the educational setting and to develop an appropriate model applicable to the existing national program for certification in medical laboratory technology in Canada.

The proposed model will account for all components of a program evaluation either in a documented narrative approach or in a detailed descriptive research fashion. In so doing, the model will document the existing methods for input, process, and product evaluation and will provide strategies for gathering additional information for a more detailed approach to input and product evaluation. This data will be gathered through a survey of heads of training programs, recent graduates, and prospective employers to assess the actual needs of the new graduates in the work place and the ability of the existing training programs to meet these needs.

The proposed model will seek to answer the following questions:

1) What are the actual competencies and essential skills required by the new graduate in the work place today?
2) Does the existing Syllabus of Studies (guidelines

for certification) reflect these actual needs and essential skills as seen by:

a) a new graduate?

b) the prospective employer?

3) What changes (additions/deletions) to the training programs and Syllabus of Studies are necessary to respond to the growing complexity of the scientific and medical field?

DELIMITATIONS

The development of a program evaluation model and the carrying out of this evaluation to validate fully all aspects of the national certification process for medical laboratory technologists in Canada is beyond the scope of any project or thesis.

Therefore, this study will limit itself to the development of an appropriate evaluation model and the design of survey instruments for the antecedent (inputs) and product (outputs) components only. The process (thruputs) evaluation by accreditation will be discussed merely in a narrative fashion.

DEFINITION OF TERMS

ACCREDITATION

Selden (1972) defines accreditation as "the process by which an agency or organization evaluates and recognizes a program of study as meeting certain predetermined qualifications or standards." (p. 54)

In this study, the accreditation of training programs in medical laboratory technology, held every five years under the auspices of the Canadian Medical Association and endorsed by the various allied health societies and associations, involves an external on-site visitation by a team of professional experts. This team, representing the various professional groups, observe the operations of the training institute and clinical facilities, measure such performance against the established set of standards/ guidelines and make specific written recommendations for continuation, improvement, or termination of a particular training program.

EVALUATION

Evaluation, used in the broadest sense, can be defined as a process of examining and collecting pertinent information on all components of a particular training program (inputs, thruputs, and outputs) in order to make knowledgeable decisions regarding the effectiveness of the particular program to achieve its goals and objectives.

In this study, the author will be evaluating the national certification program for medical laboratory technologists in Canada. This process will include all components in the program with special emphasis on the antecedent and outcome components.

CERTIFICATION

Certification is referred to as the process by which a non-governmental agency or association grants recognition to an individual who has met certain predetermined qualifications specified by that agency or association.

In this study, the author will be considering initial certification at the technologist level through the Canadian Society of Laboratory Technologists. The specific qualifications required for such certification include:

a) graduation from an accredited training program
b) completion of a specific in-service training component in an approved clinical laboratory.
c) acceptable performance on the initial certification examinations

FOLLOW-UP STUDY

A follow-up study through a mail survey is a specific instrument used to evaluate the product (graduates) of a particular training program, to gain input for program planning and improvement, and to determine the adequacy of the particular training program in preparing its graduates for job entry.

REGISTERED TECHNOLOGIST

For the purpose of this study, a registered technologist is any individual who has attained initial certification (general or subject) with the C.S.L.T. and who has maintained annual registration with the Society.

SYLLABUS OF STUDIES

A Syllabus of Studies is a point of reference or a guideline which sets the pattern for curriculum development and outlines, in behavioural terms, exactly what the student is expected to learn during the training program.

As stated in the preamble of the 1981 Syllabus of Studies, the C.S.L.T. Syllabus is to be viewed as "a guide for those intending to write the initial certification (R.T.) examinations and for all individuals responsible for the education and training of technologists preparing to write these examinations."

DIDACTIC PHASE

This represents the first phase in the two phase formal approach to the training of medical laboratory technologists in Canada. Consisting of 1-2 years in length, the didactic phase concentrates on the theoretical knowledge required in the five major disciplines (clinical chemistry, hematology, microbiology, histotechnology and immunohematology), as well as in the introductory basic sciences.

CLINICAL PHASE

The second phase of the program is a one year clinical phase in an approved training laboratory with emphasis on the practical application of the basic sciences and technical component taught in the didactic phase.

ASSUMPTIONS

In the design of this study, the following basic assumptions were made:

1. the survey questionnaires were valid instruments for the collection of desired data.
2. the questions conveyed the objectives of the study according to the intent of the author.
3. the returned questionnaires were interpreted according to the intent of the respondent.
4. the respondents were representative of the total number of graduates.

IMPORTANCE OF THE STUDY

A. BACKGROUND INFORMATION

The history of medical laboratory technology reaches back as far as the history of medicine itself. As Gibson (1964) relates, Valeris Cordus was simply called a laboratory worker even though his method of ether preparation in 1540 proved to be the basis of ether inhalation anesthesia. William Perkins, another "laboratory worker" in England, discovered methylene blue which unraveled the histopathology of the nervous system. Records show that individuals employed in laboratories throughout the early centuries were known as laboratory workers even though their discoveries contributed greatly to the future of modern medicine and the welfare of mankind.

Before the beginning of the twentieth century, formal training of medical laboratory personnel was virtually non-existent. Most laboratorians possessed very little education and were simply shown how to perform a few simple tests. The profession of medical laboratory technology had its genesis in the early part of the twentieth century when pathologists began to train assistants to perform rudimentary tasks in the analysis of body fluids and tissues as well as in autopsy work. Such training was done in the hospital laboratories and focused on practical application rather than on theoretical knowledge. Ruth Hovde (1962) contends that the field of medical technology actually developed out of the need of the medical profession to provide more service in one of the areas within the practice of modern medicine, namely, the clinical laboratory.

B. EVOLUTION OF MEDICAL LABORATORY TECHNOLOGY TRAINING IN CANADA

On May 20th, 1937, the Canadian Society of Laboratory Technologists (C.S.L.T.) was incorporated under Dominion Charter by authority of the Companies Act of Ontario. Since its inception, its major interest has been the training and national certification of medical laboratory technologists in Canada and the continuance of high standards of practice in response to rapidly changing technology in health care.

In 1940, the Canadian Medical Association appointed the C.S.L.T. as the official registry and certifying body for medical laboratory technologists in Canada. By so doing, the C.M.A. recognized that membership in the C.S.L.T. would itself be a warrant of satisfactory training experience and professional competence.

Prior to 1937, training in medical laboratory technology was done "on-the-job", and the only examination/certification available in North America was through the American Society of Clinical Pathologists (A.S.C.P.). With the formation of the new Canadian Society (C.S.L.T.), and in conjunction with the Canadian Medical Association, a conjoint program of formal and regulated courses of instruction towards Canadian certification was established.

Up until the 1960's, training was formalized within the hospital setting with each hospital meeting the standards of curriculum and practice as outlined by the professional organization (C.S.L.T.). As Atkinson (1972) confirms, this apprenticeship system of training left much to be desired. The information that rubbed off onto the student or was picked up "by osmosis" in the normal course of events of "just being in the lab", was not the type of instruction or background knowledge needed to meet the challenges of the expanding technological and scientific field. However, as pointed out by Hovde (1962), such a system seemed appropriate at a time when most "experts" believed that methodology would not change appreciably during the working life of the individual technologist.

However, the overwhelming demands and developments in all aspects of technology, medicine and science completely revolutionized overnight the professional activities of the medical laboratory technologist in Canada. Automation was in - manual methods were out. As Hovde (1962) aptly put it: "the day of the hand-maiden was over!". The end result was the recognition of the inability of clinical facilities in most hospitals to cope with the necessary didactic training to meet these changes. At the same time, political, educational and economic circumstances led to the evolution of new post-secondary institutions, community colleges and technical/vocational institutes. Therefore, it came as no big surprise when the traditional on-the-job training was transferred to these provincially centralized educational institutions who were heralded as being better equipped to handle the complex and sophisticated technologies within the health care field.

This transfer of medical laboratory technology training to the post-secondary institutions resulted in major changes in the existing program leading to initial certification. Most training programs, with the exception of university programs, consist of two or three years of theoretical and practical training depending on whether the entrance requirement to the institution was a junior or senior matriculation level. If entrance is a **junior matriculation level,** the first year at the college is essentially senior matriculation equivalent with some orientation towards the specified allied health sciences. The second year is devoted to the theory of the various clinical disciplines with some laboratory sessions to develop basic competencies. If entrance to the program requires senior matriculation level, the year at the institution is devoted to the theoretical knowledge of medical laboratory technology.

Whether the institution offers a two- or three-year program, each program is divided into two distinct phases: the DIDACTIC PHASE within the educational institute and the **CLINICAL (INTERNSHIP) PHASE** within the clinical facility, usually a clinical laboratory in a general hospital. These two phases differ considerably both in approach and in control:

1. DIDACTIC PHASE

As stated earlier, the didactic phase within the post-secondary institution concentrates on training the student in the theoretical knowledge necessary for skill development, and in most cases, exposure to the basic level of skill acquisition. Since most programs are designed towards the initial certification with the C.S.L.T., the five major disciplines are included in the didactic training, namely, clinical chemistry, hematology, microbiology, histotechnology, and immunohematology. Specific courses are also established in general and organic chemistry, anatomy and physiology, and laboratory instrumentation and orientation. In this way, the training at the R.T. (General) level adheres to the "cluster concept". An individual is initially prepared to enter gainful employment in a number of specialized areas, thus permitting a high degree of mobility and flexibility in the future.

2. **CLINICAL (INTERNSHIP) PHASE**

In the one-year clinical phase, the emphasis is on the practical application of the basic principles learned in the didactic phase and on the development of manual dexterity in working with laboratory specimens. This is accomplished through an integration of tutorial sessions and "hands-on" experience through each of the laboratory departments. The importance of this clinical component in the overall picture is summed up in the words of Rosarii (1970):

> The internship (clinical education) phase of health science programs is the "heart" of the student's educational experience. Under the tutelage of the hospital or other health facility sponsor, the student has the opportunity to learn first-hand the internal operations of his or her particular field of study. The student will furthermore, be able to apply many of the skills and concepts he/she has learned in class in the clinical situation. The combination of theoretical knowledge obtained in the classroom environment will enable the student to obtain the well-rounded background so urgently needed in our contemporary society (p. 2055).

Thus, neither the classroom nor the clinical setting provides all the new materials needed for the end product; some experiences take place primarily in one setting while others chiefly occur in the other.

Therefore, joint consultation between institution and clinical facility is critical to the success of the program. In reality, as pointed out by Atkinson (1972), a better approach would be a comprehensive program which is fully integrated both in the training centre and in the clinical laboratory.

Upon the successful completion of the program, the student is eligible to challenge the Initial Certification examinations set by the C.S.L.T. and, if successful, receives a certificate as an R.T. or registered technologist.

C. EVOLUTION OF THE SYLLABUS OF STUDIES

As the certifying body for medical laboratory technology in Canada, the C.S.L.T. must ensure that adequate standards of practice and accredited training facilities are maintained throughout the country. To facilitate this onerous task, a Syllabus of Studies is approved and periodically revised so that every technical institute/college/university responsible for the training of medical laboratory technologists will have similar aims and objectives when developing its own curriculum. It should be noted, as pointed out by Atkinson (1972), that the Syllabus is **NOT** meant to be a **curriculum** telling the various institutes how and what to teach but a general outline of topics and headings to be covered to ensure adequate preparation for initial certification examinations.

Syllabus of Studies: 1941

The first Syllabus of Studies of the C.S.L.T. was completed in 1941 and, as stated on its covering page, dealt briefly with "the scope of work which should be covered by an applicant for registration as a General or Specializing Technician". This Syllabus was divided into six major headings - Bacteriology, Biochemistry, Hematology, Serology, Parasitology and Histology - and covered two full pages. Its content reflected a field in the embryonic stage of life trying to establish itself without the advantage of formal structures and set guidelines. Within its limited scope of practice, its purpose was simply stated as:

1. "a thorough knowledge of" ...a number of stains, techniques, terminology and methods
2. "principles, normal values and methods of performing" ... a number of tests and procedures

Today, in the vise-like grip of "objectives" - student performance objectives, general objectives, specific objectives, behaviorial objectives, instructional objectives - educators would find the content and format of this first Syllabus totally unacceptable. However, at the time and with the limited facilities, equipment, and techniques available, it was totally acceptable and meaningful both to the student and to the instructor.

Syllabus of Studies: 1957

In 1957, the Syllabus of Studies underwent another revision. This time, it reflected a more formal approach to the training of medical laboratory technologists and an understanding and appreciation of the complexity and diversity of this new era in the medical and scientific field. This Syllabus, consisting of sixteen pages and five major headings - General Knowledge, Histology, Bacteriology and Immunology, Clinical Chemistry, and Hematology - also included a list of reference books at the end of each major heading. Once again, we recognize the same vague statements found in the previous Syllabus:

1. "a basic knowledge of" ...morphology, staining, methods
2. "basic principles and methods for"...

For the first time, there is an initial emphasis on such general knowledge topics as: laboratory safety, care and maintenance of laboratory equipment, specimen collection, and laboratory records.

Syllabus of Studies: 1967

The first major breakthrough in the evolution of the Syllabus of Studies came with the revision of 1967. As stated in the preamble, this revision recognized "the need for higher standards of technological knowledge and performance and the advances being made in training". It goes without saying that the changes in program delivery and transfer to approved centres outlined previously, were reflected in this new Syllabus.

Now, with the academic environment of college-based training programs, a more comprehensive and detailed Syllabus was required. The result was a Syllabus of thirty pages with six major headings - General Knowledge, Histology, Clinical Microbiology, Clinical Chemistry, Hematology and Blood Bank Technology - and an extensive list of references. The name change to "clinical microbiology" recognized the expansion of study into areas other than bacteriology such as mycology, virology and parasitology. The further recognition of blood bank technology as a separate entity was in keeping with the rapid advances in blood group systems and blood transfusion procedures. In addition, greater emphasis was placed on instrumentation, laboratory safety, anatomy and physiology, quality control, and laboratory records.

Syllabus of Studies: 1973

Under the auspices of the C.S.L.T. Certification Board responsible for all matters pertaining to the standards, method of training and certification, the 1973 revision of the Syllabus of Studies reflected a modified form of behavioral objectives. The Syllabus grew in proportion to the numerous technological advances witnessed in the late 60's and early 70's: it consisted of 36 pages, five major subject headings by discipline - clinical chemistry, clinical microbiology, immunohematology (blood banking), hematology and histotechnology (histology) - as well as an itemized citing of Syllabus resource material and additional references.

For the first time, the Syllabus adequately integrated the total training, the didactic and clinical phase of the training program, stated in very specific terms the core content to be tested at the end of the training, and referenced the sections under each heading so that both the instructor and student would know the source of the material to be demonstrated.

The disappearance of the general knowledge section recognized the need for this basic introductory knowledge within each of the specific disciplines rather than as a separate section without relationship to any specific area.

Syllabus of Studies: 1981

The most recent Syllabus revision clearly states the **purpose** of the Syllabus: a guide for those intending to write the R.T. examinations and for those responsible for the training of these technologists and the **depth of knowledge** required of a newly registered graduate. This newest Syllabus is divided into six headings and consists of 43 pages.

For the first time, the Syllabus outlines the general objectives of the total training program and of the new graduate at the R.T. level. These objectives state that the new graduate should:

a) Be able to perform basic clinical procedures within defined limits of accuracy.
b) Possess sufficient theoretical knowledge to learn to perform more complex procedures under supervision of personnel accountable for those procedures.
c) Be able to recognize and identify anomalous results due to technical errors, and common equipment malfunction.
d) Be able, under supervision, to undertake corrective measures required for (c) above.
e) Be able to assist in the implementation and

development of new techniques or improvements to existing techniques.

f) Be able to recognize when the results of a laboratory procedure fall outside clinical established normal values, and to initiate appropriate action which may include reporting through established channels and carrying out additional related tests within established guidelines.

g) Be responsible for initiating ordering of supplies.

h) Be responsible for collating statistical information pertinent to assigned duties.

i) Ensure that the laboratory is kept safe, clean and orderly.

j) Ensure that laboratory equipment used in performing tests referred to in this Syllabus, is kept safe, clean, and operational.

k) Recognize and respect the confidentiality of patient information.

l) Be able to communicate effectively with patients and hospital personnel.

(Preamble, 1981 Syllabus of Studies)

This brief account of the evolution of the C.S.L.T. and its Syllabus of Studies clearly indicates the cumulative increase in core material over the past 40 years as well as the technological advances in automation, sophisticated equipment and testing procedure. It also highlights the primary concerns that initiated this study:

1. what essential core body of knowledge is required of the new C.S.L.T. graduate by the work place?
2. can this body of knowledge continue to be learned adequately in a 20-24 month period?
3. what body of knowledge should be included

in the general initial certificate and what body of knowledge should be reserved for the speciality and advanced level of certification?

4. what skills are best learned in the clinical laboratory environment?
5. is the existing process of external accreditation appropriate and sufficient to ensure national standards?
6. does the existing Syllabus of Studies (guidelines for certification) reflect these actual needs and essential skills as seen by:
    a) a new graduate?
    b) the prospective employer?
7. what changes (additions/deletions) to the training programs and Syllabus of Studies are necessary to respond to the growing complexity of the scientific and medical fields?

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The review of related literature includes two distinct and unrelated sections:

Section One:

In order to gain the necessary understanding and appreciation of program evaluation and its growing importance in education, a comprehensive study of the definition, history, and various models of program evaluation was performed.

Section Two:

A second literature search included a review of the major evaluation instruments - interviews, questionnaires and pilot studies. This knowledge proved invaluable in the setting up of the surveys and follow-up studies.

Program Evaluation

The process of evaluation is not new to man. As a rational being, man has always been intimately involved in assessing, appraising, judging, and valuing everything around him. The history of educational and program evaluation is relatively new, dating back to the early 1900's with the advent of the accreditation movement or evaluation by external audit. This team evaluation approach described by Wentling and Lawson (1975), saw a group of experts descend upon a school for a period of three or four days to examine the facilities and materials used, to observe the actual teaching process in the classroom, and to discuss the instructional/learning process with the teachers and pupils. After this on-site examination, the team wrote a detailed report of their findings describing the observed situation and making recommendations for improvement and change.

Under the tutelage of Ralph Tyler, educational evaluation in the 1930's focused on goals and objectives, measurement by testing student outcomes. In this process, program evaluation became the assessment of student attainment of instructional objectives specified by the program developers.

The first major revolution in program evaluation came in the 1960's. During this period, the educational community witnessed the requirement of third party evaluation of federally-funded projects in the United States and Canada. This requirement provided the **NEED AND FUNDS** for the creation and the development of numerous

MODELS of evaluation. At the same time, there was a growing awareness that attainment of specific objectives was only ONE dimension of program evaluation. Instructors' performance, learning experiences, worthiness of the objectives themselves, and the unintended outcomes must also be considered within the evaluation process.

The evolution of program evaluation as cited above and the various models or strategies to such evaluations to be discussed later, compel us to ask the basic question: **WHAT IS PROGRAM EVALUATION?** Tyler (1942) would simply state that evaluation is the process of determining whether objectives have been achieved. Hammond (1973) echoes this belief as he sees program evaluation as the determination of the effectiveness of a program to achieve the intended goals and objectives. Scriven (1967) and Worthen and Sanders (1973) maintain that an evaluation is to determine the worth, value or merit of a thing. Franklin and Thrasher (1976) go beyond the narrow definition of program evaluation as the evaluation of outcomes related to the achievement of program objectives to the analysis of program inputs as well as outcomes.

Many well-known exponents of program evaluation see its primary role as providing relevant information and informed judgments to the key decision-makers. For Alkin (1972), evaluation is a process of ascertaining the decision areas of concern, selecting appropriate information, and collecting/analyzing the information to help the decision-makers in selecting reasonable alternatives. Stufflebeam (1972) presents program evaluation as a process of delineating, collecting, and providing information useful in judging decision alternatives.

Wright (1970) contends that the major differences among most definitions and models of program evaluation are primarily those of terminology, emphasis/biases, and data recording procedures. This statement may be an over-simplification of a complex process, but it does illustrate the similarities and commonalities in all the traditional models:

1. do the actual learning experiences produce the desired results?

2. how effective is the program and the instruments used in the program?

3. what are the strengths and weaknesses of the program?

4. what changes/improvements should be made in the program?

Tyler's Goal Attainment Model

Although the author does not agree with Tyler's stress on stating objectives behaviourally and on relying on achievement tests in program evaluation, it is important to recognize his influence in this area not only in the 1930's but also in our present day with the resurgent emphasis on accountability and testing.

For Tyler (1942), program evaluation contains six important steps:

1. the formulation of broad goals and objectives
2. the classification of these objectives into major types
3. the descriptions of these objectives in behavioural terms
4. the specifications of student learning experiences for the achievement of the objectives
5. the selection of appropriate means of measuring the objectives
6. the actual measurement of the achievement of the objectives
7. the comparison of actual achievement with previously established objectives.

As can be seen, the evaluation is essentially "objectives-oriented". If the goals are attained, the program is considered successful; if the goals are not attained, the program is inadequate. Atkin (1973) would object to such an evaluation because it does not question the worthiness or value of the objectives themselves, it assumes that we can readily identify the educational objectives for which we can strive and that all important outcomes can be stated in behavioural terms. He believes that the program regresses towards the objectives reflected by the test items because the teacher limits the range of his/her exploration and innovation.

Stufflebeam's CIPP Model

Stufflebeam (1966) sees the role of evaluation as a continuing process, providing information to decision-makers. His actual model is composed of four types or classes of decisions and four corresponding evaluations:

1. **Context Evaluation:**

   Context evaluation is usually employed in the planning stage when a program is first being conceived. These planning decisions will involve choices regarding program objectives based on recognized needs (student needs, employer needs, and community needs).

2. **Input Evaluation:**

   Structuring decisions involve the choosing of numerous alternatives to achieve the desired objectives. Therefore, input evaluation is the development of plans for achieving the goals and objectives based on an assessment of available facilities, staff, budget, materials and procedural designs, and resources.

3. **Process Evaluation:**

Stufflebeam (1966) felt that periodic feedback to the decision-makers would provide the necessary information for implementation of decisions regarding:

a) deviations of the program from its original design
b) implementation problem areas that need adjustment
c) interpersonal relationship problems among staff and students
d) adequacy of the resources, physical facilities, staff, and time schedules
e) necessary improvement to the ongoing program
f) positive and negative outcomes of the program

Therefore, the primary goal of process evaluation is to monitor on a continuous basis the program as it is being implemented.

4. **Product Evaluation:**

Product evaluation considers the overall effectiveness of a program by determining the degree to which the intended objectives and goals have been met and to relate this to context, input and process in the measurement and interpretation of the outcome.

Stufflebeam's model is appealing to the author as a comprehensive and realistic approach to the evaluation of occupational training programs. This model not only attempts to define and measure outcomes (the extent to which objectives are achieved) but also attempts to explain outcomes (the functional relationships between outcomes and process variables).

Evaluation by Scriven

Scriven (1967), one of the founding fathers of program evaluation, has presented us with many "approaches" to achieve the major purpose of any educational evaluation, namely, the establishment and justification of the merit, worth and value of a program.

In following through on the above purpose, Scriven avoids a personal model **PER SE** and merely highlights the various evaluations that should be considered:

1. **Formative/Summative Evaluation:**

Formative or internal evaluation is seen as part of the curriculum development process in which constant feedback would result in continual improvement of the program. Sumative evaluation, done by an external evaluator, is a means of assessing the merit of curricula once they have been developed and used. Such an evaluation would determine whether or not objectives have been met.

2. **Intrinsic/Pay-off Evaluation:**

Subsequently, Scriven describes an alternative approach to evaluation, namely, intrinsic/pay-off evaluation. This approach appears to be a further delineation of the previous formative/summative evaluation procedure.

Intrinsic or instrumental evaluation is an appraisal of the teaching instrument or process itself: content, goals, grading procedures and teaching attitudes. Pay-off or consequential evaluation looks at the end product and attempts to judge the effect of the learning environment on the student.

As Stufflebeam (1974) points out, Scriven felt that all evaluations must judge both the goals and the results in order to properly assess the overall merit of a program. Therefore, product criteria cannot be evaluated in isolation but must be seen in relationship to the process or instrument used.

3. **Goal-free Evaluation (G.F.E.):**

At a later date, Scriven (1972) developed his goal-free evaluation approach. Although it is not directly stated, the author feels that this idea evolved because of Scriven's strong emphasis on the true and appropriate role of the evaluator. He believes that the evaluator should not just present an evaluation report - pertinent information for scrutiny - but should present some objective assessment of the merit of the program that could be subsequently used in formal judgment by decision-makers. In so doing, the emphasis on evaluation must be on **ACTUAL** effects, not **INTENDED** effects. Thus, the goal-free evaluation approach was seen by Scriven as the answer.

Scriven is persuasive in his argument that the alleged goals are often very different from the real goals and that it is essential to avoid tunnel vision through a goal-free evaluation approach. In addition, the GFE is less influenced by the "powers that be" in that it is not attempting to prove/ disprove any objectives or goals but merely observing the "that which is".

Other evaluators such as Stufflebeam, Alkin and Popham have been overly kind in their criticism of the goal-free evaluation approach by Scriven. Stufflebeam (1972) sees GFE as a "methodological strategy that can be used to supplement others (models of evaluation)" (p. 4). However, it should not be approved as an alternative model of evaluation since evaluation means judgments based on standards or goals. Alkin (1972) maintains that the GFE approach DOES indeed recognize goals, but the goals are broader than the specific goals of the program under consideration. Popham (1972) sees the contribution of the GFE approach as a warning to evaluators to assess a program on the basis of all important effects, not just goals and objectives.

Stake's Countenance Model

MacKay and Maquire (1971) classify Stake's model as an electric or industrial model that focuses on the collection of data that will not only answer questions regarding the existing program but that will also pose additional questions that should be seriously considered in the determination of the worth and value of any particular program. In this way, this author senses the **completeness** of the model with its emphasis on the unintended as well as intended outcomes [referred to by Stake (1973) as the "side effects or bonuses"], the antecedent conditions, and the instructional transactions.

Although Stake's model appears somewhat complex, the rationale behind its evolution is totally logical and thorough. In the first three cells as outline in Figure 1, the **intentions** of the program are spelled out:

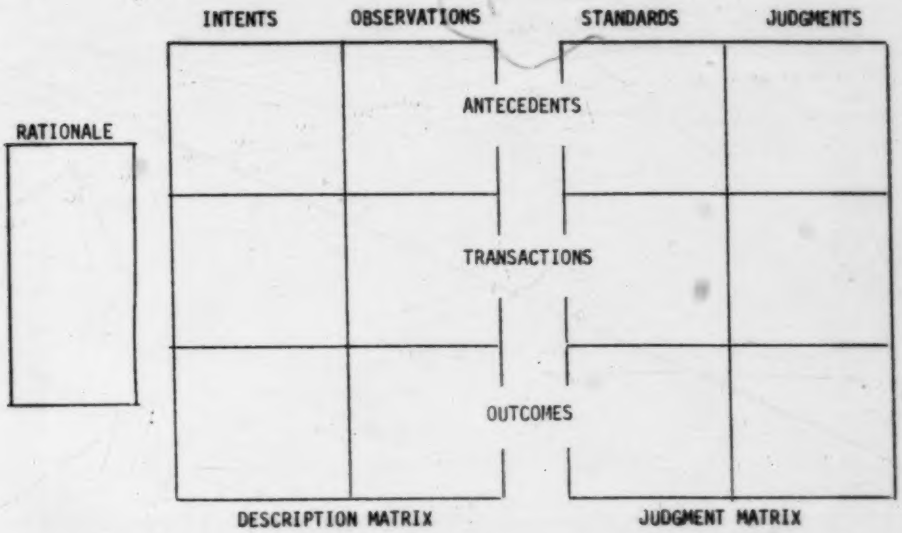
> **Intended antecedents:** Antecedents are those conditions that exist prior to the teaching/learning experience that may relate to or affect the outcome such as the facilities, teachers, and students.
>
> **Intended transactions:** Transactions are the countless encounters and activities of the student during desired outcomes. This would include the

educational climate and environment, the actual learning activities and experiences as well as psychomotor, attitudinal, and motivational development.

Intended outcomes: Outcomes are the consequences or results of the educational process and the measurement of the impact of instruction. Obviously, such outcomes are closely tied to the specific goals and objectives of the program as well as the intended transactions.

Figure 1

Robert Stake's Countenance Model


INTENTS
OBSERVATIONS
STANDARDS
JUDGMENTS
RATIONALE
ANTECEDENTS
TRANSACTIONS
OUTCOMES
DESCRIPTION MATRIX
JUDGMENT MATRIX

In the second group of cells, Stake considers what actually happens in each of these components:

Observed antecedents: This involves the actual description of what is observed regarding the facilities (classrooms, laboratories, study areas), the teachers (qualifications, interests, teaching methods), and the student (home environment, parents' expectations, cultural and social activities).

Observed transactions: What actually occurs in the day-to-day instructional system: student-teacher relationship, classroom activities, allotment of time for each activity, student-student interaction, evaluation process.

Observed outcomes: What are the immediate observable outcomes (at the end of the year) and the long range outcomes (at a later date).

Stake (1973) stresses that a complete description of all intended and observed components of a program is essential in order to make any evaluative judgments. Otherwise, judgment statements are made without sufficient documentation and defense. After the description matrix has been developed, it is possible to evaluate the "intended" and "actual" goals, means and results for congruency/discrepancy, and contingency/causal effect. In addition, this information would also allow judgmental comparisons against absolute standards and/or other similar programs.

Provus' Discrepancy Model

Malcolm Provus (1971) contends that the purpose of evaluation is to determine whether to improve, maintain, or terminate a given program. Therefore, the evaluation process requires the following steps:

1. the comparison between the existing program and some agreed-upon program standards
2. the determination of a difference or discrepancy between some aspect of the existing program and the set standards governing that aspect of the program
3. the use of this discrepancy information by decision-makers as a rational basis for program adjustments or termination.

In order to acquire the necessary information to reach the above decisions, the following development stages of program evaluation must be followed in the Discrepancy Model:

1. **Program Definition:**

   A detailed description of the program as perceived by the staff members is obtained through a brainstorming technique. This information about objectives, staff, students, and facilities and instructional activities used to reach the objectives forms the standard against which the program will be evaluated.

2. **Program Installation:**

The evaluators observe the actual process of student-teacher activity so that they can compare this reality with appropriate activity program standards developed in stage 1. Therefore, the purpose of this stage is to determine the extent to which the program has been installed as designed.

3. **Program Process:**

The evaluator collects data indicating how and/or if student behaviour is changing as predicted by the enabling objectives. It is essential to appraise learning activities for their effectiveness.

4. **Program Products:**

The evaluator seeks to answer the basic question: "has the program achieved its terminal objectives?" This is done by comparing the reality of the terminal products with the specified standard terminal products.

The strength of Provus' model lies in the involvement of the program staff in setting objectives and standards, and the collection of adequate data by which to measure the value and merit of the particular program. However, the development of the program definition/design criteria that forms the basis for the entire evaluation is subject to assumptions and perceptions that could prove faulty or misleading. In addition, this model seems to exclude a mechanism for continuous monitoring of the program.

Accreditation Model

Pennell, Proffitt and Hatch (1971) describe the evolution of the accreditation approach to program evaluation in the United States. As it was conceived in the mid-1800's, it was a voluntary mechanism of approval of specific educational programs by educators and respective professions. As each professional organization was formed, it regulated the program of study in its field and established standards of practice for its members. It is interesting to note that accreditation of health educational programs in medical laboratory technology began between 1930 and 1960 in both Canada and the United States.

The author considers accreditation an appropriate program evaluation model, particularly as it applies to national health educational programs. The purposes of such accreditation can be stated as:

1. assisting prospective students in identifying approved programs
2. assisting institutions in determining transfer credit from other institutions
3. certifying that an institution has met established standards
4. establishing criteria and guidelines for professional certification
5. creating goals for self-improvement

In North America, two professional groups have undertaken accreditation of educational programs for multiple allied health occupations, namely, the Council on Medical Education of the American Medical Association and the Conjoint Committees on Accreditation of Educational Programs for Allied Health Dsiciplines of the Canadian Medical Association. In each case, an accreditation team, through an on-site visit, observes and evaluates the educational process for the purpose of providing suggestions for improvement.

Usually, accreditation occurs every three to five years by a team of professional experts representing a cross-section of the specific educational and occupational areas. Prior to the on-site visit, each member of the accreditation team should be supplied with a description of the program to be evaluated, results of previous evaluations, demographic data related to the program, and a set of criterion questions that define exactly what is to be evaluated.

Wentling and Lawson (1975) maintain that a total program evaluation should include an assessment of the liaison between sending institutions and clinical facilities, philosophy of the program, goals and objectives, planning, administration, research and evaluation, learning resources, staffing, and physical facilities. In addition, curriculum evaluation in specific disciplines would include course objectives and their relationship to essential competencies, methodology, equipment, learning resources, student records, and evaluation process.

It should be emphasized that the accreditation team is expected to identify exemplary characteristics as well as deficient components of the program. Many evaluation teams overlook this responsibility and focus entirely on deficiencies. In addition, suggested solutions and remedies to the cited deficiencies should be considered an important part of the accreditation process.

Roemer (1974), quoting from a study of Accreditation of Selected Health Education Programs, identifies some major problems in accreditation:

1. **Accountability:**

   It is felt that the accreditation process should be accountable not merely to the health professions but to a much broader audience including students, educational institutions, governments, potential employers, and the public-at-large.

2. **Structure of Accreditation Teams:**

   Consideration should be given to lay representatives on such accreditation teams to ensure protection of the public.

3. **Financing of Accreditation:**

   The cost of accreditation should be borne by the educational institutions and the health professional organization. In Canada, this financial arrangement has been established successfully.

4. **Research in Accreditation:**

   Little research has been conducted in the field of accreditation. Research is urgently needed to determine the viability and relevance of traditional guidelines for accrediting education programs.

5. **Relationship of Accreditation and Certification:**

   Certifying agencies normally require graduation from an accredited program in establishing eligibility to certification examinations. This link in the regulation of health care occupations points to a possible weakness in the overall system if either process is weakened.

Adversary Model

Although many recognized experts in program evaluation have written about the adversary model - some in glowing terms and others in not-so-glowing accounts - it is difficult to determine its founder and chief proponent.

Levine (1973) contends that informed human judgment is as effective as the pseudo-precise instruments/designs and the imperfect mathematical processes now in vogue in program evaluation. In his comparison of the scientific method and the adversary method, Levine (1974) goes further and questions the over-reliance on the experimental method wrought with serious problems in application over the adversary approach which appears more appropriate especially in the area of psychology. Similarly, Wolf (1975) recognizes the potential power of the adversary model in the balanced presentation of human testimony and the objective human judgment subsequently rendered based on this evidence. This is in direct contrast to the existing quantification and technical analysis now in vogue within traditional approaches to program evaluation. Arnstein (1975) agrees that its major strength is in bringing a variety of facts and opinions together in a well-rounded and balanced manner. After their personal experience with the adversary model at the Counselling Centre of the University of Nebraska-Lincoln, Williams and Pinkney (1981) herald this evaluation strategy based on the judicial process as an effective alternative to standard evaluation models that fail to really affect decision- makers and/or programs. Kourilsky (1973) sees the adversary approach as an alternative to other evaluation models because unlike the traditional approach which she coined the "single recommendation approach" or expert advice approach, the adversary model presents a balanced representation of both sides of an evaluation issue.

Many writers are more guarded in their comments and proclamations regarding the adversary model. Thurston (1978) acknowledges a limited application of the adversary model in educational evaluation and sees its main contribution in the "open forum" style through which arguments for and against are presented publicly. Popham and Carlson (1977) feel that the numerous deficiencies in the model renders it totally ineffectual and inapplicable for educational evaluation.

Although the above authors may not agree on the merits of the adversary model, they do agree on the actual procedure and characteristics of this novel approach. It emulates the legal or judicial process, trial by jury, complete with prosecutor **(NEGATIVE EVALUATOR)** and defense **(AFFIRMATIVE EVALUATOR)**. It emphasizes confrontation, competition, sharpening of issues and objectivity in a forceful presentation of both sides of an issue.

In simplest terms, the adversary model is the presentation of oral arguments about a program by an **ADVOCATE** and **ADVERSARY** to a **PANEL** who then renders judgment based on the evidence heard. It provides for the structured consideration of alternative arguments and inferences which help to keep the evaluation honest and fair.

Thurston (1978), Kourilsky (1973), Wolf (1975), and Williams and Pinkney (1981) present a united front in reviewing the advantages and/or strengths of the adversary model. Briefly, they include:

1. When both sides of an issue are presented and aired, the decision-maker has a wider range and better quality of information on which to base decisions. Therefore, this should lead to more rational decisions regarding the continuance/discontinuance of a program.
2. The issue and exploration of human testimony and the recognition of the value of human intelligence making sense out of what it observes, makes the adversary model a true evaluation model.
3. The adversary model diminishes the possibility of bias and the "yes man syndrome" in which evaluators consciously or unconsciously manipulate their findings to agree with the pre-conceived ideas and personal biases of the decision-makers.
4. This model, through its "open forum" style, effectively responds to the need for public accountability and gives the program higher profile and credibility within the community.

Popham and Carlson (1977) seem ruthless in their criticism of the adversary model. However, Benson and Hiscox (1980) would agree with their conclusions. Both parties recognize the following deficiencies in such an approach:

1. There will always be some disparity in the skills of the two adversarial teams, and this disparity could lead to erroneous decisions by the panel.
2. The adversary model should only be used when a clear-cut binary choice can be made because the judicial system does not lend itself to intermediate measures.
3. An adversary evaluation is twice as expensive as a conventional evaluation.

However, Thurston (1978) would argue that the above concerns are greatly overstated. Such charges of excessive costs and possible manipulation of results are not unique to the adversary model. In addition, the adversary model does not necessarily mean a yes or no conclusion. The panel could render several decisions on various issues without providing a clear-cut guilty/not guilty verdict in the issue.

Systems Theory and Program Evaluation:

A system, according to Silvern (1972) is a structure of an orderly whole which clearly shows the interrelationships of the parts to each other and to the whole itself. The application of systems theory in education requires a total integration of program planning, curriculum development, technical training (process) and final product. Therefore, two approaches within this theory should be considered when reviewing various techniques in program evaluation.

1. **DACUM: Development of a curriculum**

Mager (1975), the modern day prophet of curriculum development, believes we often overlook the most important element in successful curriculum planning and development, namely, the establishment of an actual need for the course and of the real competencies required in the work force. Franklin and Mason (1977) would go further and argue that the main reason for lack of achievement in training programs has been the failure to identify accurately the real needs of the graduate and the employer.

Obviously, a more rational approach to curriculum identification and selection is required. Such an approach was developed in the late 1960's by the Experimental Projects Branch, Canada Development of Regional Economic Expansion and the General Learning Corporation of New York. DACUM (development of a curriculum) is a statement of an occupational profile which determines the skills required for a particular occupation. In responding to the question: "What must be learned?", DACUM bases its answer on the actual work done within a given occupation. In its present form as designed by Robert Adams (1972), Nova Scotia Newstart Corporation, DACUM is a single-sheet skill profile and rating chart that serves as both a curriculum plan and an evaluation instrument for occupational training programs.

DACUM Process

a) DACUM Committee

DACUM development utilizes the brainstorming technique within a carefully chosen group of 10-12 skilled practitioners and major specialists of a specific occupation over a period of three days. It is important to note that two groups are intentionally omitted from this committee: trained instructors in the occupation who tend to focus on the **HOW** of learning activities rather than the **WHAT** of skill behaviour required in the occupation and directors or executives who usually are unaware of the latest developments in the actual working areas. The structure of this committee is crucial and, as emphasized by the B.C. Brief on curriculum design (1975), must reflect a cross-section of industry with respresentation from large, medium and small institutions, from all geographic locations, from all levels of experience and from all subtrades or disciplines within the occupation.

The group leader, acting as a catalyst, will prove to be the most important member of this committee. He does not need to be knowledgeable about or have extensive experience within the particular occupation. In fact, these characteristics may prevent him from remaining objective. However, he does need a broad background in curriculum development and task analysis and fluency in group dynamics in order to conduct the procedures effectively. He will examine the quality and accuracy of definitions presented, confirm the accuracy and validity of Committee evaluations and suggest re-evaluation where needed.

b) **DACUM Procedure**

The Coordinator leads the Committee through a series of steps:

(i) **Pre-DACUM Session**

An orientation session for all committee members should be held prior to the actual beginning of the DACUM session. At the preliminary committee meeting, the

Coordinator would explain the DACUM process and review the purpose, procedure and end product desired during the three day session. Mason (1984) would encourage that time be spent at this session or during the first morning to deal with the expectations and concerns of the group. This would establish a climate of trust, build group feeling and eliminate negative reaction to the actual DACUM process.

(ii) **General Areas of Competence:**

Through group discussion and brainstorming, the Coordinator assists in identifying the General Areas of Competence, based on actual conditions of employment, in which the individual must be proficient in order to obtain and maintain employment. Such division of skills may be related to specific divisions in the work assignments or areas into which the occupation naturally divides, or they may be merely a convenient method of grouping the skills. These General Areas of Competence, usually eight to twelve in any occupation, are then printed on 3 x 5 cards that can be easily stuck on the wall for all to see and review.

(iii) Individual Skills:

Individual skills for each General Area of Competence that the individual must learn to become competent in the field are arranged in a horizontal band or row adjacent to the appropriate General Area of Competence. These skills are also printed on 3 x 5 cards that are stuck on the wall as in the previous step. No stress is placed on sequence of events and each row must be completed before another is begun. Since these skill definitions are destined to become learning units in the training program, they must reflect realistic future as well as current requirements and must be explicit enough to eliminate misinterpretation.

(iv) Learning Sequence:

Each row is carefully reviewed and a horizontal sequence is established according to the priority given to each skill by the occupation. Therefore, in structuring the skills into a learning sequence, consideration must be given to skills needed early in the occupation, skills that are prerequisite to the learning of other skills that are most likely to be applied in many learning activities.

(v) **Structure of Skills into Finished Profile:**

The entire structure is examined to identify similarities or duplications which may result in minor changes. Once again, Mason (1984) refines the original procedure by Adams by encouraging the members to review the chart individually before the group review. This allows the less vocal members of the group to participate and ensures a comprehensive and all-inclusive final profile.

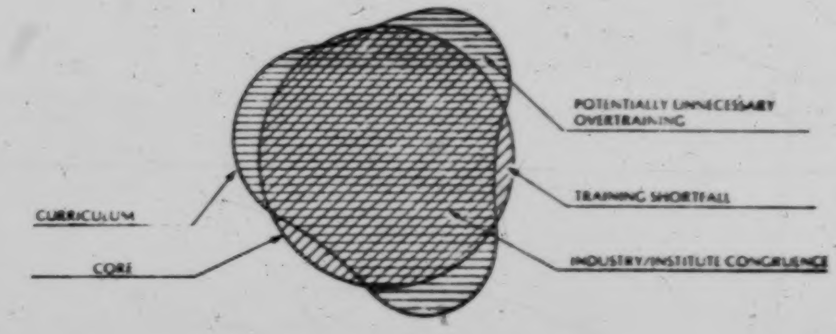
(vi) **Final Inspection**

The DACUM chart is now complete. The skill definitions are now typed, numbered mounted and photoreduced for printing. Franklin and Mason (1977) insist that the skills shown in the DACUM chart be validated before the chart is published.

Worger and Morgan (1983) describe the validation process used at the Northern Alberta Institute of Technology. The list of skills under each general area of competence is sent out to a large sample of NAIT graduates and prospective employers. The graduates are asked to distinguish between "entry-level" skills while the prospective employers are asked to indicate the level of competence required for each skill at the end of one year of working experience. The analysis of this information, will indicate core content from "nice to know" or unnecessary curriculum and will identify training shortfalls or overtraining as shown in Figure 2.

FIGURE 2

ANALYSIS OF VALIDATION RESPONSES


POTENTIALLY UNNECESSARY OVERTRAINING
TRAINING SHORTFALL
CURRICULUM
CORE
INDUSTRY/INSTITUTE CONGRUENCE

c) RATING SCALE

Adams recognizes the difficulties in the evaluation of occupational training programs by applying precise measurement to a complex occupation and artifical performance standards (e.g. time restraints) that have very little bearing on performance in a real world situation. Therefore, DACUM focuses on observable behaviour and on realistic work situations in the same way that the employer in industry would view them. Each skill on the DACUM chart is defined in terms of the observable behaviour and it is on this behaviour only that an individual is rated by himself or another. This also assumes that there are several defined categories in the scale so that distinction of measurements and change could take place.

2. CAP System (Competency Analysis Profile System)

In the early 1970's, two professors from the Faculty of Education, University of Alberta, developed a systems theory, the CAP System, as a viable approach for the development of training programs. Based on competencies and on the development of performance levels within a given occupation, it was designed to be used in the development of curriculum. As outlined by its authors, Manuel and Deane (1976) and Deane and Manuel (1977), there are five distinct phases in this CAP System:

Phase I: Development of the Profile

The profile referred to throughout the text is a comprehensive document of specific competence categories and complimentary competency statements required within a given occupation. Competent practitioners, selected on the basis of experience, specialization and work environment, develop this profile during an intensive brainstorming session. It is assumed that individuals working in the field have the most relevant information about the competencies required to function satisfactorily in the field.

The actual procedure is quite similar to the DACUM theory approach. A leader, skilled in group dynamics, leads the group to the development of a series of broad competency categories with complimentary competency statements describing the specific skills within each category.

Once the profile has been established, the team concentrates on rewording in precise behavioural terms. The resultant profile is now ready for validation by a much larger group of practitioners.

Phase II: Validation of the Profile

The resultant CAP profile is now submitted to a larger segment of the occupation for scrutiny. This group will validate each competency category and statement, will add or delete competencies and statements as deemed appropriate to ensure that the final profile truly represents the entire occupation and will rank each skill or competency according to its relative importance.

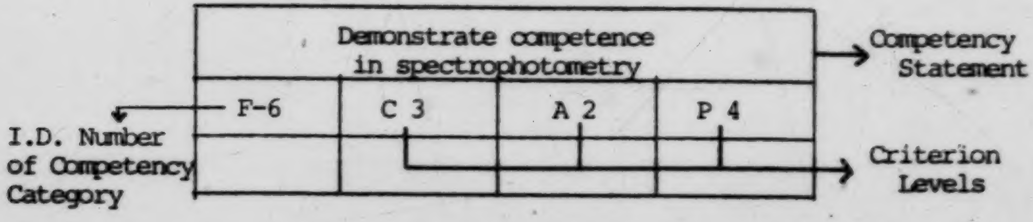
Phase III: Specification of Competencies

The validated profile is now used by a new team of experts (including educators with proven experience in writing educational objectives) in the development of performance objectives and learning activities for each competency statement. Proficiency levels related to the three learning domains (Cognitive, Affective and Psychomotor) are also prescribed and evaluation criteria are established. Each domain has four levels and the group must determine the minimum level for each domain of a competency block (see Figure 3).

FIGURE 3

COMPETENCY STATEMENT

WITH CRITERION LEVELS


Demonstrate competence in spectrophotometry
Competency Statement
F-6
C 3
A 2
P 4
I.D. Number of Competency Category
Criterion Levels

The final product will be a booklet containing competency categories and each competency statement with the criterion levels for each of the domains of learning.

Phase IV: Preparation of Learning Resources

The CAP profile will now be used to develop self-contained learning modules for each competency statement. The learner will have complete access to these modules as well as alternate learning resources. These resources may include existing learning materials from other programs or commercial companies. The essential components of a module would include a cover page, introduction, performance objectives, pre-assessment procedure, learning experiences and post-assessment measurement.

e) **Phase V: Establishment and Management of Delivery Systems**

This final phase attempts to interface the learner and the learning resources best suited for the attainment of his/her desired competencies. Records on individual learning progress are maintained and continuously updated.

The CAP system is a very practical response to the need for modularized learning activities in flexible occupational training programs.

EVALUATION INSTRUMENTS

The actual choice of an evaluation instrument for the collection of data is based on the probable response rate, the expense, the complexity of information required and the speed with which answers must be obtained. The author will limit this literature review to a discussion on the use of the questionnaire and interview. Reference will also be made to pre-testing of the evaluation instrument as a means of ensuring the reliability and validity of responses.

Questionnaire:

The basic questionnaire is a useful instrument for gathering pertinent information at low cost from a large number of people living at a distance from the investigator. As pointed out by Bennett and Ritchie (1975) and the handbook on questionnaire design from Statistics Canada (1979), the visual appearance of the questionnaire may either arouse the respondent's interest or discourage him from cooperating.

Berdie and Anderson (1979) and Warwick and Leninger (1975) provide a series of suggestions to help stimulate a high percentage rate of response:

(i) highly personalized relationship with respondents.

(ii) professional looking correspondence and photo off-set questionnaire design. Printing allows the use of different sizes and styles of type to distinguish questions from instructions.

(iii) strong appeal to altruism and the importance of the study

(iv) use of sponsoring organization letterhead, if applicable

(v) stamped, addressed return envelopes

(vi) follow-up by mail or telephone

McCallon and McCray (1975) also stress anonymity as a means to obtain more accurate information. In this way, a person can express whatever he wishes without the fear of reprisal.

Introductory Letter:

The front page or introductory letter should include an outline of the purpose of the study, the identification of the sponsoring organization, if applicable, the general instructions for completion and return of the questionnaire and the required date for completion. The handbook by Statistics Canada (1979) also stresses the necessity of providing assurances of the confidentiality to be given to the data provided.

Construction of the Questionnaire:

The preliminary identifying information includes questions on respondent characteristics - age, sex, marital status, education, occupation - that will be used for classification purposes in the tabulations and analysis. The wording used should be familiar to and appropriate for thesurvey population. Precise instructions should be included on how to move ahead, how and when to skip certain questions and so on.

It is advantageous to begin the questionnaire with a few interesting and "non-threatening" questions, including open-ended questions, that are sufficiently easy to give the respondent confidence to proceed further.

Two main question types may be defined, the open-ended and the closed question. An open-ended question does not suggest any specific response while the closed question requires the respondent to choose his answer from a given, limited selection. Due to the difficulty in statistically analyzing open-ended responses, this type of question is seldom used effectively. Closed questions may vary considerably in form and the questionnaire may contain check lists, ranking, two choice and multiple choice questions. In phrasing questionnaire items, the investigator should aim at communicating with the lowest rather than the average educational level of the potential population.

After designing the questionnaire, it is important to evaluate its validity and reliability or its potential usefulness as an instrument of measurement. Validity refers to the extent to which the questionnaire adequately probes the various areas it is supposed to measure (content validity), whether the questionnaire results agree with present theories on the relevant areas of the research (construct validity) and the practical usefulness of the questionnaire as an instrument of identification (concurrent validity). We must also consider how reliable are the measurements by looking at internal consistency (consistency of answers to items).

Frequency counts are the principle index of data analysis for two choice or multiple choice questions. The chi-square can also be used to determine any significance of frequency differences. Responses to questions involving a rating scale and calling for a numerical value can be considered as direct input to a statistical analysis such as analysis of variance.

As stated previously, open-ended questions are difficult to analyze statistically. In order to compare responses, some form of "content analysis" is usually performed and responses are arbitrarily coded to a standard set of response categories designed by the investigator. Bennett and Ritchie (1975) maintain that this interpretative and judgmental procedure may be subject to considerable error and may destroy the main characteristic of open-ended questions by changing them into closed questions in order to apply standardized statistical analysis.

Before the questionnaire is finalized, the investigator should set up a series of "dummy" tables with detailed column headings and line captions to indicate how the data will be summarized.

Warwick and Lininger (1975), Richardson, Dobrenwend and Klein (1960) and Bennett and Ritchie (1975) present a detailed outline of the advantages and disadvantages of the questionnaire. An investigator needs to weigh these benefits and limitations before choosing the evaluation instrument for the specific study. The advantages of a questionnaire include the ease of establishing contact, the ability to traverse geographical distances, the minimal cost, the possible sample size, the uniform question presentation, the ability to proceed at your own speed, and the ease of completion. On the negative side, the potential low response rate which could jeopardize validity, impersonalization and misinterpretation of questions may cause serious problems with any study.

Pretesting

Even if all prescriptions are followed completely, there is no guarantee that the proposed questionnaire will fully satisfy the objectives of the study. Therefore, it is essential that a rigorous pretesting of the questionnaire be implemented to determine whether the research objectives are likely to be met by the proposed questionnaire.

This pretesting or pilot study should be performed with a sample of individuals who are similar to the individuals who will ultimately receive the actual final questionnaire. It is further recommended that the questionnaire might also be sent to "experts" in the field who can critique the investigator's efforts constructively.

Sletto (1940) enumerates the many benefits and rewards of such pretesting. It will increase the proportion of returns as well as the reliability and validity of responses, detect procedural mistakes before they exact heavy penalties, and formulate general acceptance of test wording, sequence, layout, choice of types of questions and use of questioning techniques. This should appease the critics who frequently and justly condemn the use of questionnaires in research endeavours.

INTERVIEW:

A survey is conducted to collect information in order to reduce one's uncertainty about existing affairs and/or to assist in future decisions in this regard. One of the most successful and widely used survey instruments in the interview.

To improve and ensure the success of any interview, Adams (1958) recommends adherence to the following procedure:

(i) **Establish rapport:** The success of any interview depends on the investigator's ability to create an atmosphere of confidence and trust with the prospective respondent. The first impression made on any respondent is very important and sets the stage for any further communication.

(ii) **Setting:** The interview should be conducted in a quiet, comfortable area. Since the presence of other individuals may influence or bias the respondent's answers, the interview should usually be done in private.

(iii) **Use of a questionnaire format:** The validity and reliability of the interview will be enhanced by the use of a questionnaire format. However, even with a set of questions, the investigator must be careful to follow the set procedure exactly: ask every question on the questionnaire, ask the questions in the order as presented and precisely as specified in the instructions. Any deviation in the format or presentation may jeopardize the potential value of the data and its analysis.

(iv) **Closing of the interview:** At the end of the interview, another attempt should be made to return to any questions deliberately skipped because of threatened rapport and fear of honest response. In addition, the respondent should be assured at all times of the confidentiality of any information obtained during the interview. Finally, the respondent should be thanked for his/her participation.

(v) **Recording responses:** Responses should be recorded at the time they are made. The investigator should not rely on personal recall at a later date. When responses do not adhere to the established categories or procedures, the interviewer should be diligent in recording the exact words and phrases used by the respondent. This information may then be useful in the data analysis.

Richardson, Dobrenwend and Klein (1965) state that the use of the interview must be based on an objective assessment of its advantages and limitations in terms of the information to be gathered, the available sources of information and the personal characteristics and skills of the investigator. Warwick and Lininger (1975) list the advantages of the interview as improved motivation of the respondent, greater flexibility in asking questions and in clarifying ambiguous questions and answers, independence from educational background and visual acuity and control over administration and sequence of questions. The disadvantages would include the expense, inappropriate sampling and failure to follow instructions in questioning.

CHAPTER THREE

METHODOLOGY AND INSTRUMENTATION

Design of the Model

Having reviewed the various models and strategies in program evaluation, the author designed a comprehensive evaluation model applicable to any professional/technical program and used in this study to evaluate the national certification program in medical laboratory technology. This model is graphically presented in Figure 4.

FIGURE 4

EVALUATION MODEL FOR NATIONAL PROGRAM IN MEDICAL LABORATORY TECHNOLOGY

ANTECEDENTS (Inputs)	PROCESS (Thruputs)	PRODUCT (Outputs)
1. Needs Assessment - student needs - program needs	1. Accreditation Process - organization - objectives - learning resources - facilities - personnel - evaluation process	1. Certification Process - examination results
2. DACUM Charts - needs of prospective employer		2. Follow-up Survey - new graduates
3. Professional Organization (C.S.L.T. - professional needs		3. Employer Survey - prospective employer

A. Antecedents (Inputs):

An extensive needs assessment (student needs, employment needs, and professional needs) was developed to provide necessary information for the establishment of overall goals and objectives for a national program for medical laboratory technology.

1. **Needs Assessment Survey**

A questionnaire was designed and administered to the program heads of all approved training programs in Canada (as listed in Appendix A) regarding admission requirements and program structure. This questionnaire provided specific information in the following areas:

a) **Admission Requirements:**

(i) A list of matriculation subjects required for admission

(ii) The minimum G.P.A. required for admission

(iii) The use of interviews/references in selection process

(iv) Any additional requirements for admission

(v) Admission regulations following junior or senior matriculation

b) **Program Structure:**

(i) Length of didactic phase in institute.

(ii) The time required to teach/learn the theoretical knowledge and practical competencies required by the new graduate.

(iii) The skills best learned in the clinical laboratory environment.

(iv) The content of the Syllabus of Studies in relationship to:
  a) essential theory, competen~~cies~~ and/or skills
  b) non-essential theory, competencies and/or skills
  c) advanced level theory, competencies and/or skills

(v) The relationship between the C.S.L.T. Syllabus of Studies and examinations and the actual needs of the new graduate in the work place.

2. DACUM Charts in Medical Laboratory Technology

The assessment of the needs of the employer was seen as an essential component in the establishment of a realistic and comprehensive national program of study in medical laboratory technology. This would ensure that the program would reflect the theory, competencies and skills required by the new graduate in the actual work place.

Since the author did not believe in "inventing the wheel" to obtain this information, the two existing DACUM charts - as shown in Appendices B and C - representative of two major geographical regions in Canada (Alberta and Ontario) were used in this study. It was assumed that these DACUM charts, validated by a follow-up survey of graduates and/or an employment survey of prospective employers, would adequately represent the actual needs of the new graduate in the work place across Canada. This information was reviewed and critiqued and subsequently used in the development of the proposed follow-up survey and employer survey.

3. Professional Certifying Organization

In establishing the antecedents, some consideration must be given to the administrative policies and guidelines established by the national certifying body, the Canadian Society of Laboratory Technologists. It must be recognized that although a great deal of flexibility is allowed within each educational institution and clinical facility, the approved Syllabus of Studies must be adopted as the basis for program development and approval and therefore, prospective students must be academically prepared for these requirements. The author will study the needs of the profession by a brief review of the history of admission requirements and length of training programs.

B. Process (Thruputs)

Each approved training program in medical laboratory technology in Canada is subject to an accreditation by an external evaluation team every five years. This accreditation, under the auspices of the Conjoint Committees on Accreditation of Educational Programs for Allied Medical Disciplines of the Canadian Medical Association, judges whether the program fulfills the required objectives and is being implemented as planned. Following the "Basis for Accreditation" guidelines, this team will review program components: organization, objectives, instructional activities, evaluative procedures, personnel, didactic and clinical facilities, libraries and study areas, and resources.

The author will review the present accreditation process, its strengths and weaknesses, and will pose suggestions for possible greater effectiveness through more institutional and "external" participation in the actual accreditation process.

C. Product (Outputs)

In order to obtain an accurate and realistic measurement of the product (the graduate) and the overall effectiveness of the national program, the following instruments for data collection were designed:

1. **Certification Examination Results:**

   The results of the initial certification examinations held every June and October were examined for a five-year period (1980-84). It is believed that the success rates will provide some factual indication of the relative effectiveness of the national certification program.

2. **Follow-up Survey:**

   A student follow-up survey (1982-84) was designed to provide necessary information regarding the strengths and weaknesses of the training program as well as its ability to prepare graduates for the work place.

3. **Employer Survey:**

A mail- questionnaire/rating form was designed to survey prospective employers regarding the new graduate's performance on the job. This will help to assess program objectives in relation to desired competencies in the field.

The DACUM charts previously reviewed and the present Syllabus of Studies were useful in the design of the follow-up and employer surveys.

The author recognized the possible weaknesses and disadvantages of questionnaires but felt that they were the instrument of choice for this study since the individuals to be surveyed were located throughout Canada. In addition, the time and cost involved in using a more acceptable technique, such as the interview, made it prohibitive.

To improve the validity of all survey questionnaires, they were field tested and revised where necessary before being included in the model. The needs assessment survey was reviewed, amended and approved by the members of the Certification Board; the follow-up survey was reviewed by the members of the Certification Board, piloted by a random sampling of graduates living in Alberta and revised accordingly; the employer survey was reviewed by the members of the Certification Board, piloted by a random sampling of prospective employers in Alberta and revised accordingly.

To ensure a good return to the surveys, a letter of support from the professional organization (C.S.L.T.) was drafted to be included with the questionnaires and the stamped addressed return envelope. The author is confident that the survey response will be high (over 80%) since the individuals to be surveyed (graduates and employers) are intimately involved in and concerned with the thrust and focus of the study.

Design of the Instrument

1. Needs Assessment Survey

The needs assessment survey package is included as Appendix D. The training program questionnaire was developed as outlined in the initial design of the model. A letter of support from the professional organization, a note ensuring confidentiality of information and a stamped return envelope addressed to the author and stamped "PERSONAL AND CONFIDENTIAL" were also included with each questionnaire.

Since the C.S.L.T. is a recognized bilingual professional organization, all information outlined above was translated into French to facilitate responses from the C.E.G.E.P. training programs in the Province of Quebec.

This package was reviewed and amended by the Certification Board of the C.S.L.T. and was revised accordingly by the author prior to distribution. The author's initial intention was to design this needs assessment survey only. However, as the development of the instruments progressed, it was recognized that data from this survey could prove invaluable in the design of the follow-up and employer surveys. Therefore, the needs assessment package was designed and distributed to all training programs in Canada in late November, 1984.

In January,1985, with only 50% of the questionnaires returned, the author sent a follow-up letter to encourage greater participation in the survey. The inappropriate timing of the initial questionnaire (Christmas mailing) was the cause of this poor response and the letter of reminder resulted in a final response of over 85%.

2. Follow-up Survey

Initially, a follow-up survey was proposed to poll a test sample of 1,500 randomly selected graduates (1980-84) from training programs across Canada. The total population to choose from would be 5,402 graduates. The author further proposed a stratified random sampling to ensure an appropriate representation of graduates by sex, location, programs, etc.

However, further investigation favoured the reduction of the number of years to be investigated from five years (1980-84) to three years (1982-84). It was felt that it would be difficult to recall actual training practices and procedures beyond a three-year period. In addition, the C.S.L.T. agreed to finance a follow-up survey of all graduates between 1982 and 1984, namely 2,411 individuals. Since registration with the C.S.L.T. is not compulsory for employment, some bias may still be present even if the entire population is surveyed since some graduates are no longer registered members in good standing. However the author believes that this is the best sampling possible in the given situation.

The follow-up survey package, incorporated as

Appendix E, includes the following information:

a) a letter of support from the professional organization

b) an instruction page of detailed guidelines for the completion of the questionnaire

c) each section of the questionnaire will be color-coded for ease of response and data analysis. This is important because each graduate answers only certain sections of the questionnaire

d) the entire package will be typeset to improve its professional quality and visual appeal

e) five prizes for free 1986 C.S.L.T. membership will be offered as an incentive for the prompt completion of the questionnaire

f) a stamped return envelope addressed to the author and marked PERSONAL AND CONFIDENTIAL

g) all information will be translated into French to facilitate responses from the Francophone graduates

Since the actual survey will not be carried out as part of this study, the author was careful to include three methods of pretesting the survey package: the entire package was designed with the assistance of the instructional staff of the Medical Laboratory Science program at the University of Alberta. Each instructor received the general information and her specific discipline section to critique for wording of questions, format, and accuracy of content. The package was then reviewed and revised further by the C.S.L.T. Executive staff and the Certification Board. As a final check, the questionnaire was piloted by the fourth year students of the Medical Laboratory Science program who represent a sampling of the graduates who would ultimately receive the final package. The author feels that this pretesting has been quite rigorous and that the final product will produce the desired results.

3. Employer Survey

The design of the employer survey package was the easiest section of the entire study because the covering letter, instruction page, and questionnaire followed the same format and content as the final follow-up survey.

However, the establishment of an appropriate sampling of the prospective employer population caused some concern to the author. When the diversity of prospective employers was considered - hospitals, clinics, private laboratories, government laboratories, research laboratories, educational institutions as well as industrial and commerical organizations - it was recognized that an accurate sampling would be impossible since a composite listing of all employers was not readily available. Therefore, recognizing this as a further delimitation of the study, the author decided to survey a sampling of hospitals, clinics, and private laboratories in Canada since these employers account for 80%-90% of all medical laboratory technologists. A listing of all Canadian hospitals was available from the Canadian Hospital Directory and a similar listing for clinics and private laboratories in the major provinces of Ontario, Alberta, and British Columbia was available from the respective provincial organizations. Since a 500 bed general hospital is considered the "standard" size for the purpose of comparative studies, a stratified random sampling of 500 hospitals (400-600 beds) was recommended. All major clinics and private laboratories in the three provinces were included in the sample.

The employer survey package, submitted as Appendix F, included the following information:

a) a letter of support from the professional organization

b) an instruction page of detailed guidelines for the completion of the questionnaire

c) each section of the questionnaire will be color-coded for ease of response and data analysis. This is important because each employer answers only certain sections of the questionnaire

d) the entire package will be typeset to improve its professional quality and visual appeal

e) a stamped return envelope addressed to the author and marked PERSONAL AND CONFIDENTIAL

f) all information will be translated into French to facilitate responses from Francophone employers

Since the actual survey will not be carried out as part of this study, pretesting of the survey package by two groups was included: the entire package was reviewed by the C.S.L.T. Executive office staff and the Certification Board for format, wording, and accuracy of content.

After revision, the questionnaire was piloted by a sampling of prospective employers within the Edmonton area, including hospitals and private laboratories. The author feels that the final version of this employer survey package will produce a valid and reliable response from participants which can be used in program evaluation by the C.S.L.T.

It goes without saying that the potential number of responses that could be generated by the graduate and employers surveys necessitates the use of computer data software in the analysis and interpretation of data.

Therefore, the C.S.L.T. should consider the use of either optical scorer sheets or the development of a proper coding system for all variables in each survey. Obviously, the author would recommend the use of optical scorer sheets in the printing of each questionnaire as this would eliminate the time consuming key punching procedure and reduce the possibility of errors in transcribing the data onto the computer cards.

CHAPTER FOUR

PRESENTATION AND INTERPRETATION OF FINDINGS

A. ANTECEDENTS (INPUTS)

1. Needs Assessment Survey:

Twenty-seven (87.1%) of the training program questionnaires were completed, returned and tabulated. Through the calculation of frequency distributions, the following data was recorded:

Table 1: Distribution of Responses

British Columbia	2	(100%)
Prairie Provinces	6	(100%)
Ontario	10	(90.1%)
Quebec	6	(66.7%)
Maritime Provinces	3	(100%)

Table 2: Admission Requirements

1. Admission to program from:	a) grade 11	2	(7.4%)
	b) grade 12	19	(70.4%)
	c) grade 13	3	(11.1%)
	d) grade 12 or 13	3	(11.1%)
2. Required subjects at above level:			
	a) Chemistry	27	(100%)
	b) Mathematics	26	(96.3%)
	c) English	16	(59.3%)
	d) Combination (physics or biology)	10	(37.0%)
	e) Physics	10	(37.0%)
	f) Biology	5	(18.5%)
	g) Combination (2 of physics, math and biology)	2	(7.4%)

Table 3: Minimum/Mean Average Required

a)	per subject	range:	50% - 65%
b)	overall		60% - 70%
c)	mean average/successful candidate		
(i)	1984-85:	range:	60% - 80%
(ii)	1983-84:		65% - 80%
(iii)	1982-83:		63% - 77%

Table 4: Additional Admission Requirements

a)	medical examination	: 13	(48.2%)
b)	personal interview	: 12	(44.4%)
c)	letter of interest/ personal objectives	: 11	(40.7%)
d)	tour of laboratory/ hospital interview	: 8	(29.6%)
e)	references	: 5	(18.5%)
f)	pre-entrance testing	: 5	(18.5%)
g)	none	: 2	(7.4%)

Interpretation:

The above information provided a general summary of entry antecedents and academic requirements for a medical laboratory program in Canada.

These findings indicated the recognized need of a strong foundation in the sciences, especially Chemistry and Mathematics, for entrance into and successful completion of the program. At the same time, it indicated one possible weakness in the admission requirements, namely, the omission of English as a compulsory course in 6 out of the 22

(27.3%) English programs. Since good communication skills are an essential element in the profession, this omission was found to be inappropriate and professionally weak.

It was noted that the mean high school average of successful candidates was much higher than the required overall averages cited by most institutional programs. This was not surprising or unusual in a specific professional program with limited or quota enrolment. The additional admission requirements seemed appropriate and demonstrated the renewed emphasis on comprehensive knowledge of the profession, on personal objectives, and motivational factors.

Table 5: Program Structure (Didactic Segment)

1. Length of program: 2 years : 7 (25.9%)
    3 years : 17 (63.0%)
    2 or 3 years : 3 (11.1%)
2. Length of didactic training: 16 - 22 months: 18 (66.7%)
    9 - 10 months: 9 (33.3%)
3. % of first year (in two-year didactic programs) DIRECTLY related to medical laboratory technology:
    a) less than 25% : 9 (50.0%)
    b) 25% - 50% : 7 (38.9%)
    c) 50% - 75% : - (0%)
    d) over 75% : 1 (5.6%)
    e) no response : 1 (5.6%)
4. Sufficient time to TEACH core content?
    a) two-year program: Yes: 13 (72.2%)
    No : 5 (27.8%)
    b) one-year program: Yes: 6 (66.7%)
    No : 3 (33.3%)

Interpretation:

The general consensus favoured a two-year didactic segment for the program. Four of the "YES" responses from the one-year program, indicated some reservation in the continuance of a one-year program citing student stress and frustration, inability to teach necessary communication skills and limited concentration on core subjects as reasons for dissatisfaction. One program head summed it up nicely by stating that "if the trend (towards unlimited information) continues, either the required information will have to be restricted or the time (of program) will need to be lengthened".

Table 6: Program Structure (Clinical Segment)

1. Length of clinical training: 11 - 12 months: 19 (70.3%)
8 - 10 months: 7 (26.0%)
no response : 1 (3.7%)

2. Structure: a) "hands-on" system: 20 (74.1%)
b) simulated system : 3 (11.1%)
c) both a) and b) : 3 (11.1%)
d) no response : 1 (3.7%)

3. Sufficient time to TEACH practical competencies?
Yes: 21 (77.8%)
No : 4 (14.8%)
No Response: 2 (7.4%)

Table 7: Skills Best Learned in the Clinical Laboratory Environment

a)	communication/interpersonal relationships	13	(48.1%)
b)	organizational/prioritising skills	12	(44.4%)
c)	instrumentation/automation	12	(44.4%)
d)	phlebotomy/specimen procurement	6	(22.2%)
e)	application: theory to practice	6	(22.2%)
f)	proficiency in practical skills	6	(22.2%)
g)	handling stressful/stat situations	4	(14.8%)
h)	record keeping	4	(14.8%)
i)	interpretive skills	4	(14.8%)
j)	professional responsibilities	3	(11.1%)
k)	trouble shooting	3	(11.1%)

Interpretation:

The program heads felt more satisfied with the clinical segment than with the didactic segment. However, there was still some concern regarding student pressure "to perform", outdated/unnecessary material in the Syllabus, certain disciplines included in the general certification program and insufficient time for practical competencies in some disciplines and in simulated programs.

The list of skills best learned in the clinical laboratory environment was very enlightening to the author. The majority of these skills, practical in nature in a "hands-on" situation, cannot be tested in a written multiple-choice examination. In addition, there is some question whether such skills can be taught or learned (e.g. handling stressful situations) in a professional program. Therefore, it will be quite difficult to evaluate the success of the program in this regard.

Table 8: Summary (program Structure)

1.	**Sufficient time to teach/learn core content:**				
a)	**Didactic segment:**	**Yes:**	**18 (72.0%)**	**No:**	**7 (28.0%)**
b)	**Clinical segment:**	**Yes:**	**22 (88.0%)**	**No:**	**3 (12.0%)**
c)	**Total Program :**	**Yes:**	**23 (92.0%)**	**No:**	**2 (8.0%)**
d)	**No Response :**	**2**			
2.	**Sufficient time to teach/learn practical competencies:**				
a)	**Didactic segment:**	**Yes:**	**15 (60.0%)**	**No:**	**10 (40.0%)**
b)	**Clinical segment:**	**Yes:**	**19 (76.0%)**	**No:**	**6 (24.0%)**
c)	**Total program :**	**Yes:**	**19 (76.0%)**	**No:**	**6 (24.0%)**
d)	**No response :**	**2**			

Interpretation:

In co-relating the above summary to the previous section, the author noted one very significant point. Although 76% of the program heads felt that there was sufficient time within the TOTAL PROGRAM to teach/learn the required practical competencies, only 60% felt that there was sufficient time for such competencies in the didactic portion of the program. In addition, only 72% felt that there was sufficient time to teach/learn core content in the didactic segment where the bulk of theoretical teaching/learning is carried out. The author found these figures to be very significant and worthy of further study. These figures seem to confirm the need for a three-year program with two years in the didactic segment.

Table 9: Validation of Syllabus

1. Does the Syllabus of Studies contain theory, competencies, and/or essential skills required by the new graduate?

Yes: 12 (44.4)

No : 13 (48.2%)

No Response: 2 (7.4%)

2. Does the Syllabus of Studies contain theory, competencies, and/or skills that are not essential/required by the new graduate?

Yes: 13 (48.2%)

No : 10 (37.0%)

No Response: 4 (14.8%)

3. Does the Syllabus of Studies contain theory, competencies, and/or skills that should be reserved to an advanced level?

Yes: 3 (11.1%)

No : 22 (81.5%)

No Response: 2 (7.4%)

4. Do the C.S.L.T. examinations adequately reflect:

a) the Syllabus of Studies? Yes: 20 (74.1%)

No : 5 (18.5%)

No Response: 2 (7.4%)

b) the needs of the graduate? Yes: 11 (40.7%)

No : 9 (33.3%)

Unknown: 2 (7.4%)

No Response: 5 (18.6%)

Interpretation:

It was significant that almost half of the program heads felt that the Syllabus of Studies did not contain essential theory, competencies and skills needed by the new graduate. We may have to "live with" this situation to some degree since the process of Syllabus revision is time consuming and makes an up-to-the-minute Syllabus an impossible task. However, one must remember that the Syllabus is only a GUIDE and should not be regarded as the final word on medical laboratory technology. At the same time, the author recognized that there are some areas that need attention such as parasitology, serology, and certain sections in microbiology.

Almost half of the program heads felt that they are teaching and examining in non-essential areas. Without going into a long list of specific tests in each discipline, the responses questioned the emphasis on manual methods and obsolete testing procedures.

The purpose of any professional training program is to meet the needs of the graduate and of the work place. It is extremely significant that less than half (40.7%) of the program heads felt that the C.S.L.T.'s product evaluation process (examinations) reflected this purpose. Many respondents felt that the examination questions were totally irrelevant to current practice.

Although not specifically requested, many respondents commented on the examinations themselves. There was a great deal of concern over inconsistency in weighting of questions, importance of topics and required depth of knowledge.

2.DACUM Charts in Medical Laboratory Technology

A quick review of the limited information available on the use of DACUM in the education of health care workers clearly reveals that the originator, Robert Adam's, is probably the only individual using the DACUM process and resulting rating chart as they were initially designed! It would appear that most educators including medical laboratory technology instructors are indifferent to the original purpose of the DACUM system and agree with Sinnett (1974) that DACUM is only a tool, a means to an end, and as such should be flexible and capable of changing and evolving with use.

This evolution and change is quite evident in the formation and execution of the actual DACUM Committee. The two DACUM charts under consideration in Appendices B and C were developed by educators and clinical instructors with minimal input from working technologists. Therefore, they do not truly represent the "real job" type of curriculum which the original DACUM prescribed.

Another evident discrepancy was the establishment of the General Areas of Competence. Adams' procedure (1972) for the determination of specific skills required in a particular occupation failed to identify "the skills required **BY WHOM** in the particular occupation". Do we consider the skills needed by a new graduate or the complete gamut of the entire field of medical laboratory technology regardless of experience or level of classification? This became a crucial question when examining the existing DACUM charts since they contained numerous competencies required by a new graduate AND by a senior or supervisory technologist.

The DACUM chart was designed to be used as a student syllabus and as a cumulative record of student performance. Therefore, it should contain

ONLY those Areas of Competence required by a new graduate. Although the skill definitions were intended to reflect future as well as current requirements and the Committee was requested to predict what skills will be needed in the immediate future, a specific skill should not be included unless there was a clear indication that the graduate will be expected to apply the skill in his first job.

Adams (1972) also recognized two extreme tendencies of a Committee faced with the assignment of breaking down and sorting the individual skills of its occupation: breaking skills down too finely until they actually represented the tasks within the skill or making skill definitions too encompassing or writing them in terms of global definitions. It is a natural reaction either to overestimate the occupation in the number of skills it contains or to analyze the skills improperly due to a lack of actual working knowledge in the occupation. The author believes that Appendix C contains the **tasks** within each skill rather than the individual skills only.

Due to the above concerns and deviations, the author questioned the validity of either DACUM chart and therefore, used them sparingly in the preparation of the follow-up and employer surveys.

3. Professional Certifying Organization

In its Charter of Incorporation (1937), the C.S.L.T. cited the improvement of qualifications and standards for medical laboratory technologists in Canada as its main objective. This mandate has continued for almost fifty years.

Initially, senior matriculation with chemistry, either physics or biology and mathematics was required for admission into an approved training program. The Report from the Long Range Planning Committee (1979), approved by the C.S.L.T. Board of Directors, phased out the professional organization's participation in the assessment of educational qualifications. The responsibility for assessment of entry level requirements is now the responsibility of the respective Community College or Institute of Technology which offers the program. However, as will be noted in the results from the needs assessment survey of the educational institutions, the requirements for admission have not changed appreciably over the years.

As outlined in the previous background information, on-the-job exposure to the major disciplines was the pattern of training in the early years of the C.S.L.T. In the 1960's, there was a definite trend towards a more formal structure with a two-phase approach to training:

a) **DIDACTIC TRAINING:** given in an academic setting and consisting of lectures, assignments, and laboratory demonstrations

b) **CLINICAL TRAINING:** one year in an approved training laboratory with emphasis on the practical application of the basic sciences and technical component taught in the didactic segment of the program.

These changes coincided with the establishment of the C.S.L.T. Certification Board and a newly defined certification program in recognition of the rapidly expanding field of medical laboratory technology. The Submission to the Royal Commission on Health Sciences (1969) stressed that the training for medical laboratory technologists in Canada should be for a period of 18 months with a minimum of 4-6 months in the didactic setting. Although the literature from the C.S.L.T. no longer specifies the actual length of a training program (in months), the needs assessment survey showed that the minimum length of the training program is 18 months, 9 months of didactic training and 9 months of practical training.

B. PROCESS (THRUPUTS) EVALUATION BY ACCREDITATION

All allied medical educational programs are accredited by the Conjoint Committee of the Canadian Medical Association in conjunction with the respective associations and societies. It is the author's personal belief that this method is effective and appropriate as a process evaluation for occupational training programs such as medical laboratory technology. Therefore, the author's program evaluation model would continue the process as outlined below.

The purpose of the national conjoint accreditation, as stated in the Basis of Accreditation (1982), is as follows:

(i) to provide an external audit for programs
(ii) to bring to educational programs a national perspective
(iii) to assist in maintaining national standards
(iv) to promote national portability of qualifications
(v) to monitor changing patterns of practice and

developments in health care and, where necessary, to see that such changes are incorporated into program design

(vi) to offer advise and assistance to existing programs (page v)

The specific requirements for accreditation in medical laboratory technology include all aspects of training in both the didactic and clinical phase of each program to ensure that the quality and standards of training will qualify candidates to write the certification examinations set by the registering body, the Canadian Society of Laboratory Technologists.

1. **Program Objectives:**

The accreditation team will examine the objectives of each program and the methods used to evaluate the students' success in meeting these objectives. To provide the maximum opportunity for success, each program must incorporate the following elements:

(a) adequate performance of all clinical laboratory procedures outlined in the Syllabus of Studies for national certification.

(b) proficiency in the safe and effective use of all laboratory equipment and apparatus.

(c) recognition of results falling outside the acceptable reference criteria and appropriate action in such cases.

(d) collation and understanding of statistical information and quality assurance procedures.

2. Length of Program:

At present, a minimum of 20 months (preferably 24 months) following senior matriculation or equivalent is approved as the acceptable length of an educational program in medical laboratory technology to ensure that students can meet all the program objectives.

3. Components of the Program:

The essentials of the training program must include adequate didactic and practical instruction and clinical bench instruction to ensure that all aspects of the required disciplines are understood:

General Orientation
General Laboratory Knowledge
Clinical Biochemistry
Clinical Hematology

Clinical Microbiology
Immunohematology
Histotechnology

(a) **Didactic Phase:**

The academic or didactic phase should operate with the assistance of an Advisory Committee representing associated groups and participating clinical laboratories. This will ensure effective integration of and liaison between the didactic and clinical components of the program as well as the maintenance of national standards and relevant curriculum content.

Personnel offering didactic courses should possess appropriate qualifications and clinical experience in the area(s) they teach with additional evidence of current clinical exposure and continuing professional education. The period of instruction should be at least one academic year.

(b) **Clinical Phase:**

Clinical practical training of 10-12 months takes place in an accredited clinical laboratory under adequate supervision. All instructors should have relevant qualifications and clinical experience to ensure a high level of training in all disciplines.

Instructor/student ratio should be conducive to the attainment of program goals and objectives and consistent with good teaching practice.

4. **Educational Facilities:**

The accreditation team will assess the adequacy of the physical facilities as they tour them. This will include:

(a) adequate classroom and laboratory facilities
(b) suitable study areas in both didactic and clinical areas
(c) library facilities
(d) learning resource facilities
(e) modern equipment

5. **Program Records:**

The accreditation team will also review all student, instructional and administrative records during its on-site visit. This review will include:

(a) **Student records:**

- admission records with official transcripts
- evaluation records of student progress
- health records (immunization)
- rotation schedules in clinical portion of training

(b) **Instructional records:**

- procedural/instructional manuals
- log books
- tests, examinations

(c) **Administrative records:**

- minutes of committee meetings
- policies on selection and promotion procedures
- curriculum revision policies

C. PRODUCT (OUTPUTS) EVALUATION

1. Certification examination results:

As stated previously, the success rate on examinations will usually give some indication of the effectiveness of a national certification program. In fact, Tyler (1942) and many others would go so far as to insist that if an examination truly measures the goals and objectives of a program, a high success rate means that the program is successful and a low success rate indicates that the program is inadequate.

Appendix G represents the R.T. initial certification examination results during the past five years (1980-1984). Based on the above premise, this success rate indicates that the overall national certification program for medical laboratory technologists in Canada is quite successful.

This is not surprising. The admission requirements are quite rigorous and guarantee that each program will lure the academic "cream of the crop" from the secondary school system. In addition, the extensive evaluation process in the didactic and clinical segments serves to eliminate the undesirable. Therefore, those who survive **SHOULD** pass! Thus goes the argument of the "defenders of the system" who insist that the examination results are an accurate reflection of the quality of the program and the dedication of the instructors.

Although the national certification program is a good program that turns out a good product, the author feels that there are areas of concern that should be considered/analyzed in the product evaluation:

a) **INFLATED MARKS VS. ACTUAL MARKS**

Each training institution and clinical facility is provided with a copy of all previous examinations. The question banks for these multiple-choice examinations are extremely limited and, therefore, the examinations do not change appreciably from year to year. Many teaching technologists maintain that given the appropriate examinations over a five year period, they could "program" most individuals with average intelligence and no laboratory experience to pass the certification examinations.

If this is true - and the author believes it is - it could mean that many individuals have "beat the system" and that the published marks are not really a reflection of the quality of the program and the trainees but a record of the student's ability to memorize set questions and answers.

b) **ALLEGED GOALS VS. REAL GOALS:**

Examination results, the successful fulfilment of stated objectives, do not respond to the more basic question of Atkin (1973), namely, the merit and value of the objectives/program. Does the existing training reflect the actual needs and essential skills required by the new graduate and the prospective employee?

These questions will be dealt with in greater detail in the chapter on conclusion/recommendations.

2. **Follow-up Survey/Employer Survey**

Since this study does not include the actual collection and analysis of data from the above surveys, there will be no data analysis performed. However, the author will indicate how the generated data should be analyzed when the surveys are completed at a later date. Since the procedure for statistical analysis for both follow-up and employer surveys will be identical, they will be discussed as one unit at this time.

As stated previously, the final questionnaires will be designed to accommodate the use of optical scorer sheets or key punching technique for data analysis. This will facilitate the use of SPSS (Statistical Package for the Social Sciences) for data analysis. Once the questionnaires have been returned, the following procedure will be followed:

1) a number of DATA FILES, a separate file for each major section, will be created using the scorer sheets or coded results from both surveys. Separate files are essential because of the number of variables, and the variation in number of responses per section.

2) once (1) has been completed, the distribution characteristics of each variable under investigation will be obtained and examined. This will include frequency distribution, variability, and central tendencies of each variable. The author will be most interested in the MEDIAN and MODE of each variable.

3) investigations will be carried out to establish the relationship between two or more of the variables. This will

include crosstabulation analysis and correlation analysis.

4) since similar information from different groups will be obtained, the difference of proportions of these groups will be compared to see if a significant difference is present (independent t-test and ANOVA).

Proposed Statistical Applications

A. Frequency Distributions:

In order to properly determine the significance of the data, particularly median and mode for each variable, the C.S.L.T. decision-makers (Board of Directors, exam panels, and Certification Board) must determine **WHAT** should be considered **SIGNIFICANT** data. For example, if 40% of all responses feel that a particular item (variable) on the Syllabus should no longer be included, consideration should be given to removing it from the Syllabus during the next revision.

B. Crosstabulation Tables:

After the distribution of each variable has been examined and interpreted as stated above, the relationship between two or more variables can be investigated by the use of crosstabulation tables. The author believes that this will provide significant information for the study. For example, we can examine the relationship between examination requirements and work place requirements or the relationship between the level of knowledge required at the work place and the depth required by the Syllabus of Studies as shown in Table 10 and Table 11, respectively.

TABLE 10: EXAM REQUIREMENTS VS. WORK PLACE REQUIREMENTS

		Should be Required for Examination	
		YES	NO
Required in the work place	YES	AREA 1	AREA 2
	NO	AREA 3	AREA 4

TABLE 11: LEVEL REQUIREMENT IN THE WORK PLACE VS. DEPTH OF SYLLABUS OF STUDIES

		Depth of Syllabus of Studies		
		TOO DETAILED	OKAY	NOT DETAILED ENOUGH
Level of Requirement in the Work Place	NICE TO KNOW			
	OFTEN NEEDED			
	ESSENTIAL			

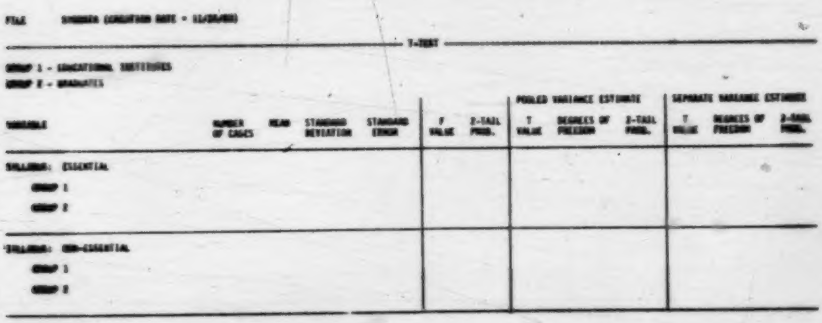
Once again, the C.S.L.T. decision-makers must determine WHAT is to be considered significant. For example, if the result in Area 1 in Table 10 was 70%, meaning that 70% feel that this particular item (variable) is required for both the examination and the work place, the Syllabus revision committee could confidently retain this item. Conversely, if the result in Area 4 in Table 10 was 70%, meaning that 70% feel that this particular item (variable) is not required for either the examination or work place, the Syllabus committee could confidently delete this item.

C. **T-test:**

Similar information will be requested and obtained from different groups, namely, heads of training programs, graduates and employers. Therefore, the difference of proportions of these groups should be compared to determine if there is a significant difference present. This can be done by means of an independent sample t-test and F-test.

For example, a t-test should be used to compare results from graduates vs. employers and graduates vs. heads of training programs for certain individual items (variables). In this case, the group means will be the basis of comparison as shown in Table 12 and Table 13.

TABLE 12: EDUCATIONAL INSTITUTES VS. GRADUATES



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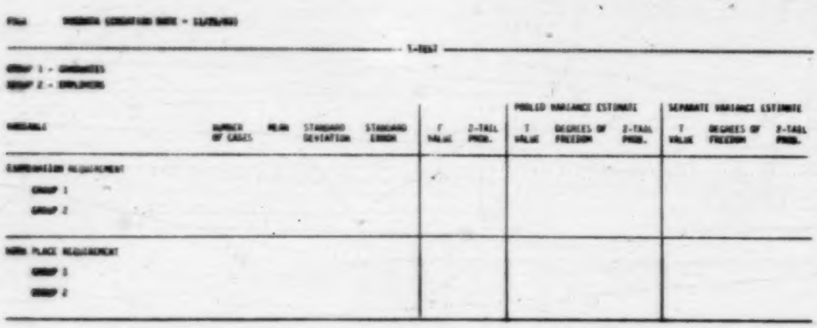
T-TEST

GROUP 1 - EDUCATIONAL INSTITUTES
GROUP 2 - GRADUATES

							POOLED VARIANCE ESTIMATE			SEPARATE VARIANCE ESTIMATE		
VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
SYLLABUS: ESSENTIAL												
GROUP 1												
GROUP 2												
SYLLABUS: NON-ESSENTIAL												
GROUP 1												
GROUP 2												

TABLE 13: GRADUATES VS. EMPLOYERS



T-TEST

GROUP 1 - GRADUATES
GROUP 2 - EMPLOYERS

							POOLED VARIANCE ESTIMATE			SEPARATE VARIANCE ESTIMATE		
VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
EXAMINATION REQUIREMENT												
GROUP 1												
GROUP 2												
WORK PLACE REQUIREMENT												
GROUP 1												
GROUP 2												

Through the above illustration tables, the author feels that it is possible to obtain numerous frequency distribution tables, cross-tabulations or correlation analysis which will be useful in revising the educational programs, Syllabus of Studies and C.S.L.T. examinations to more adequately reflect the needs of the new graduate and employer.

CHAPTER 5

RECOMMENDATIONS, CONCLUSIONS AND SUMMARY

This study has resulted in numerous significant recommendations that should be implemented or further studied by the C.S.L.T. These recommendations are classified under three headings.

A. **Primary recommendations:** This category would include those recommendations based directly on the information and data collected during this study.

B. **Related recommendations:** Although not based specifically on the information and data gathered in this study, these recommendations are noteworthy and based on the observations and personal experiences of the author who has been intimately involved in medical laboratory technology in Canada for over twenty years. During this time, the author has worked as a general technologist, charge technologist, supervisor of laboratories and co-ordinator of training program and has been a member of the Board of Directors of the C.S.L.T. for six years as well as President of the Alberta Society of Medical Laboratory Technologists

(ASMLT) and the Canadian Society of Laboratory Technologists.

C. **Recommendations for further study:** These recommendations are presented as follow-up to this study, the extensive literature review and the initial findings of the study.

A. Primary Recommendations:

Recommendation #1

Competency in the language of instruction, English or French, should be compulsory for admission into all programs of medical laboratory technology in Canada. In addition, foreign students for whom English is a second language, should be required to successfuly complete a TOEFL examination or equivalent test for English competency.

Good communication skills, spoken and written, are essential elements in the medical profession constantly dealing with life and death situations. Foreign students for whom English is a second language, gravitate to the medical profession, particularly medical laboratory technology and major problems associated with language competency and communication skills continue to plague these students at examination time and in the work place.

Recommendation #2

The didactic segment of all training programs should be a minimum of two years.

The needs assessment survey shows that over one-third of all training program heads feel that the time spent in the didactic segment is not sufficient to teach/learn the core content and practical competencies. This is a significant finding and confirms the author's contention that a two year didactic component should be compulsory.

In addition, the increased time would allow for one general science year to include some optional courses such as English/French, communications and psychology as well as 25% introductory courses in medical laboratory technology. The second didactic year would be dedicated exclusively to the theoretical aspects of the profession. This arrangement should create a better teaching/learning atmosphere and should produce a more rounded curriculum.

Recommendation #3:

The clinical segment of the program should not be conducted exclusively/primarily by simulation.

Although simulation has its place in the educational process, it should not be used as the clinical setting for practical instruction in medical laboratory technology. There are many important learning experiences such as stat situations, irate doctors/nurses, unrealistic work load demands and the health care team concept that cannot be simulated properly in a classroom setting.

Recommendation #4:

The Syllabus of Studies must continue to remain relevant through a proper validation process in the work place to ensure it is meeting the needs of the graduates and the employers.

Almost one-half of the program heads surveyed felt that the Syllabus of Studies does not contain the essentials for employment and that it contains a great deal of non-essential requirements. This is a significant finding and indicates the need to follow through with a graduate and employer survey to determine the actual needs in the work place. This study includes the design of appropriate questionnaires for this purpose. These questionnaires also attempt to validate the significant conclusions from the needs assessment survey by including pertinent questions regarding admission requirements and program structure.

B. Related Recommendations:

Recommendation #1:

The author would recommend the adoption of the following additional admission requirements taken from Table 4:

a) medical examination including appropriate immunization for medical laboratory technologists.

b) tour of clinical laboratory facility

c) personal interview or references

Although not tested in this study, the author's personal experience as an educator indicates that most student applicants lack sufficient familiarity with the profession to make a career choice. In addition, T.V. medical shows such as Quincy present an unrealisitic view of the world of the medical laboratory technologist and produce unattainable "visions of grandeur" in the viewer. A properly conducted tour and personal interview would help to dispel such notions and put the profession into perspective.

Recommendation #2:

A national study should be conducted to determine the feasibility and implications of requiring a compulsory two year didactic segment for each training program.

In light of the present educational and health care budget constraints and various philosophies regarding the role of the technical institutes and community colleges, this recommendation may not be readily supported by provincial governments and funding agencies. The need and importance of this change will have to be effectively and forcefully presented.

Recommendation #3:

The skills best learned in a clinical laboratory environment as presented in Table 7 should be reviewed and implemented by each individual clinical teaching facility.

Since these skills are deemed essential in the work place, they should be emphasized in theory and practice during the clinical year in the hospital.

Recommendation #4:

The Canadian Medical Association should re-evaluate its role in the accreditation of health care programs and take the necessary steps to effectively enforce established standards of practice and guidelines for professional certification.

As stated previously, the author believes that a process evaluation by accreditation is effective and appropriate for occupational/professional training programs. At the same time, the author contends that this process could be even more effective and meaningful with certain modifications and appropriate changes.

One fundamental concern with the accreditation process is that it appears that an accreditation team has no clout OR refuses to use its clout and authority to effectively force necessary changes to correct deficiencies in various training programs, particularly in medical laboratory technology. Each individual committee or team seems to hesitate to cite **MAJOR** problems within its report (a **MAJOR** problem could mean the withdrawal of full accreditation until steps have been taken to remedy the situation) and, for this reason, many serious deficiencies continue to exist that weaken the overall system of accreditation and certification. Examples of program deficiencies that continue to be glossed over are:

(1) the variation in training time spent in the didactic and clinical segments of each program

(2) the variation in scheduled rotational time spent in each major discipline during the clinical segment of each program, particularly the major disciplines of histotechnology and immunohematology

(3) major changes in government commitment to the educational training of health care workers

(4) detrimental effects of staff cuts and budget restrictions

Recommendation #5:

The Conjoint Committee on Accreditation should consider the feasibility and advantages of combining various aspects of the adversary model with the accreditation model for process evaluation of health care training programs.

It is the view of the author that this suggestion could result in greater introspection and participation by the total educational mileau - institutional administrators, didactic and clinical instructors, and students. An advocate and adversary group so formed from the above representatives, would present the strengths and weaknesses of the program to the panel, the accreditation team. It would call for an honest appraisal of all aspects of the training program without fear of censorship or reprisal at a later date.

Recommendation #6

The C.M.A. should consider the feasibility of establishing permanent regional accreditation teams to conduct on-site inspections of training programs.

Accreditation calls for an in-depth on-site inspection of all aspects of a training program. This cannot be done adequately in a few hours. It has been the author's experience that most inspection teams spend no more than one day evaluating an entire University program including didactic and clinical segments, instructional staff, facilities, and resources.

The author recognizes that accreditation teams are composed of volunteers from the various professional organizations and that these individuals cannot be released from their professional duties for an extended period of time. However, if the C.M.A. and the professional organizations truly believe in the need and value of accreditation, they must consider other alternatives in the composition of accreditation teams that would allow adequate time for the necessary in-depth study.

Recommendation #7

The C.S.L.T. should adopt a similar policy to the American Society of Clinical Pathologists (A.S.C.P.) regarding the actual distribution of copies of certification examinations.

The A.S.C.P. refuses to release copies of its M.T. certification examinations to any educational institute or interested individual. However, it does circulate numerous examples of question format and weighting guidelines to assist students and instructors in preparing for such examinations.

Recommendation #8:

The C.S.L.T. should re-evaluate its present examination emphasis, format and structure to determine if they are valid, reliable and relevant.

Although not part of this study, many concerns regarding the present examination process and subsequent results have surfaced during this investigation. The author would strongly recommend the services of an educational research centre such as the McLaughlin Examination and Research Centre in Edmonton to conduct an extensive evaluation of the present multiple-choice certification examinations. This evaluation would include an **ITEM ANALYSIS,** the evaluation of each item and how it was answered, to indicate the difficulty and discrimination indices and the effectiveness of the distractors. The information obtained from this analysis should be used by the examination panels to improve the certification examinations.

Recommendations for Further Study:

Recommendation #1:

To support primary recommendation #1 regarding language competency and communication skills, a national comparative study should be conducted to determine any significant differences in success rates on R.T. certification examinations between students **WITH/WITHOUT** English/ French.

Recommendation #2:

Similarly, to support primary recommendation #2 regarding a compulsory two year didactic segment, the following comparative studies should be conducted:

(1) attrition and failure rates in one year vs. two year didactic training programs

(2) R.T. examination results between one year vs. two year didactic training programs

Further Conclusions:

As stated previously, the distribution, collection and interpretation of the follow-up and employer surveys is beyond the scope of this study. However, the analysis from these studies should adequately respond to the concerns and research questions posed at the beginning of this study:

a) **Antecedents (inputs):**

(i) the changes and revisions required in the Syllabus of Studies to meet the needs of the new graduate and the prospective employers

(ii) the ability of the present training programs to teach the essential theoretical knowledge and practical skills in the allotted time frame of 20-24 months

(iii) the skills best learned in the clinical laboratory environment

b) **Product (outputs):**

The analysis and comparison of the responses from the graduates and prospective employers should establish answers and recommendations regarding:

(i) the actual competencies and essential skills required by the new graduate and the work place today

(ii) the disciplines that should continue to be included in the general R.T. certification programs

(iii) the body of knowledge considered essential for the general certification program

Summary

The evaluation model designed in this study to evaluate the national certification program in medical laboratory technology in Canada is an appropriate model for the evaluation of any professional/technical program.

Specifically built on Stufflebeam's CIPP model, it is unique in its total integration approach to the evaluation of a training program. For this reason, it could also be classified as a Systems Theory approach to evaluation since it includes all aspects of the program (inputs, thruputs and outputs) and all groups directly or indirectly involved in the actual training of medical laboratory technologists (medical profession, professional organization, training institutions, graduates and prospective employers).

GLOSSARY OF MEDICAL TERMS

Biochemistry (clinical chemistry) - the study of chemical reactions occurring in living organisms.

Hematology - the science dealing with the study of blood and its diseases.

Histology (histotechnology) - microscopic study of the form and structure of the various tissues making up living organisms.

Immunohematology (blood banking) - typing, processing, and storing of blood.

Microbiology (bacteriology) - the study of minute living organisms including bacteriology, molds, and pathogenic protozoa.

Immunology - the scientific study of immunity.

Parasitology - the scientific study of parasites.

Serology - the study of antigen-antibody reactions in vitro.

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APPENDIX A

APPROVED TRAINING PROGRAMS
FOR MEDICAL LABORATORY TECHNOLOGY
IN CANADA

MEDICAL LABORATORY TRAINING PROGRAMS IN CANADA

Newfoundland

College of Trades and Technology
Medical Sciences Department
Topsail Campus, Topsail Road
ST. JOHN'S, Newfoundland
A1C 5P7

New Brunswick

New Brunswick School of Medical Technology
Saint John Campus, Granview Avenue
SAINT JOHN, New Brunswick
E2L 3V1

Prince Edward Island

Students from P.E.I. take the academic phase of their training at the Nova Scotia Institute of Technology

Nova Scotia

Nova Scotia Institute of Technology
5685 Leeds Street
HALIFAX, Nova Scotia
B3K 2T3

British Columbia

Cariboo College
900 McGill Street
KAMLOOPS, B.C.
V2C 5N3

British Columbia Institute of Technology
3700 Willingdon Avenue
VANCOUVER, B.C.
V5C 3H2

Quebec

CEGEP de Rimouski
66 ouest rue Evêché
RIMOUSKI, P.Q.

CEGEP de Ste-Foy
2410 Chemin Ste-Foy
Ste. Foy, P.Q.
G1V 1T3

CEGEP de Shawinigan
972 Ste. Ursule
Trois-Rivieres, P.Q.
G9A 1P1

Dawson College
350 Selby Street
MONTREAL, P.Q.
H3Z 1W7

CEGEP de St. Jean
30 Boulevard De Seminaire
ST. JEAN, P.Q.
J3B 5J4

CEGEP de Chicoutimi
534 Est Rue Jacque-Cartier
CHICOUTIMI, P.Q.
G7H 1Z5

CEGEP de Sherbrooke
475 Rue Parc
SHERBROOK, P.Q.
J1H 5M7

CEGEP de Rosemont
6400- 16 rème Avenue
ROSEMONT, P.Q.
H1X 2S9

CEGEP de Saint-Jérôme
455 Rue Fournier
ST. JEROME, P.Q.
J7Z 4V2

Ontario

Algonquin College, Rideau Campus
200 Lees Avenue
OTTAWA, Ontario
K1S 5B8

Hotel Dieu Hospital
155 Ontario Street
ST. CATHERINE, Ontario
L2R 5K3

Canadore College
1300 Gormanville Road
NORTH BAY, Ontario
P1B 8K9

Cambrian College
885 Regent Street South
SUDBURY, Ontario
P3E 4T2

St. Lawrence College
King St. W. & Portsmouth Avenue
KINGSTON,Ontario
K7L 5A6

Toronto Institute of Medical Technology
222 St. Patrick Street
TORONTO, Ontario
M5T 1V4

Mohawk College
Medical Laboratory Division
Chedoke Campus
P.O. Box 2034
HAMILTON, Ontario
L8N 3T2

Fanshawe College
P.O. Box 4005, Oxford Street E.
LONDON, Ontario
N5W 5H1

Lambton College
London Road
P.O. Box 969
SARNIA, Ontario
N7T 7K4

Thunder Bay Institue of
Medical Technology
McKellar General Hospital
325 S. Archibald Street
THUNDER BAY, Ontario
P7E 1G6

St. Clair College
2000 Talbot Road West
WINDSOR, Ontario
N9A 6S4

Manitoba

Red River Community College
Room #A325
2055 Notre Dame Avenue
WINNIPEG, Manitoba
R3H 0J9

Saskatchewan

Kelsey Institute
Idylwyld Drive &33rd Street
P.O. Box 1520
SASKATOON, Saskatchewan
S7K 3R5

Medical Laboratory Technology
University of Regina
REGINA, Saskatchewan
S4S 0A2

Alberta

Northern Alberta Institute
of Technology
11762 - 106 Street
EDMONTON, Alberta
T5G 2R1

University of Alberta
Medical Laboratory Science
B-117 Clinical Sciences Building
EDMONTON, Alberta
T6E 2G3

Southern Alberta Institute
of Technology
1301 - 16th Avenue, N.W.
CALGARY, Alberta
T2M 0L3

APPENDIX B

ONTARIO DEPARTMENT OF EDUCATION
DACUM CHART
MEDICAL LABORATORY TECHNOLOGY PROGRAM

GENERAL AREAS OF COMPETENCE

01 Collect samples

02 Perform Laboratory Tests

03 Maintain quality control

04 Operate and maintain instruments

05 Maintain supplies

05 Prepare laboratory materials

07 Maintain safe environment

08 Maintain records

09 Work as a member of the health care team

10 Evaluate methods and procedures

11 Teach students and members of the health care team

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
10. EVALUATE METHODS AND PROCEDURES	PURSUE INFORMATION OF NEW METHODS AND PROCEDURES	ASSESS RELATIVE EFFICIENCY OF METHODS	ASSESS IMPACT OF METHOD ON PATIENT COMFORT
	ASSESS RELATIVE PRECISION AND ACCURACY AMONG METHODS AND PROCEDURES	ASSESS SAFETY OF METHODS AND PROCEDURES	IDENTIFY PROBLEMS WITH TECHNIQUE
	RECOMMEND CHANGES FOR IMPROVEMENT OF METHODS OR PROCEDURES	INITIATE APPROVED METHODS AND PROCEDURES	

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
11. TEACH STUDENTS AND MEMBERS OF THE HEALTH CARE TEAM	LIASE WITH OTHERS IN PREPARING SCHEDULES OF ROTATION FOR STUDENTS	ASSIST WITH THE DESIGN OF STUDENT PROJECTS, ASSIGNMENTS AND TESTS	LECTURE STUDENTS
	EXPLAIN AND DEMONSTRATE TECHNIQUE	ASSIST STUDENT IN RESOLVING PROBLEMS	EVALUATE STUDENT AND PEER PERFORMANCE
	ASSIST IN ORIENTATION OF NEW STAFF AND STUDENTS	LIAISE WITH COLLEGES	ARRANGE IN-SERVICE PROGRAMS
	ATTEND IN-SERVICE PROGRAMS		

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
09. WORK AS A MEMBER OF THE HEALTH CARE TEAM	MAINTAIN PROFESSIONAL ETHICS AND CONDUCT	MAINTAIN PROFESSIONAL CONDUCT IN STRESSFUL SITUATIONS e.g. CHILD DYING	ADVISE OTHERS OF LABORATORY SERVICES AND ASSOCIATED PROTOCOL
	DISCUSS MUTUAL PROBLEMS WITH MEMBERS OF HEALTH CARE TEAM	LIAISE WITH OTHER DEPARTMENTS AND INSTITUTIONS	RESOLVE CONFLICT CONSTRUCTIVELY
	CONSULT OTHERS	RESPOND TO ENQUIRIES	QUESTION IMPROBABLE AND INAPPROPRIATE REQUESTS

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
08. MAINTAIN RECORDS	RECORD MAINTENANCE PERFORMED ON EQUIPMENT	PREPARE, RECORD, FILE AND ACCESS STAFF WORK SCHEDULES	PREPARE, UPDATE AND ASSESS LIST OF PERSONNEL FOR EMERGENCY CALL BACKS
	PREPARE, UPDATE AND ACCESS FILE OF SUPPLIERS	PREPARE, UPDATE, FILE AND ACCESS STUDENT PERFORMANCE RECORDS	FILE TEMPERATURE CHARTS
	PREPARE, FILE, UPDATE AND ACCESS FILE ON REFERENCE INSTITUTIONS	UPDATE, FILE AND ACCESS BLOODBANK REFERENCE FILES	RECORD AND FILE COMMUNICATIONS WITH OTHER MEMBERS OF HEALTH CARE TEAM
	FILE AND ACCESS QUALITY CONTROL RESULTS	PREPARE, UPDATE, FILE AND ACCESS PATIENT IN-LAB FILES	ENSURE DELIVERY OF LAB TEST REPORTS FOR CHARTING
	PREPARE, UPDATE AND ACCESS METHOD AND PROCEDURE MANUAL	PREPARE, FILE AND ACCESS WORKSHEETS	COUNT & REPORT D.B.S. UNITS (DAILY & MONTHLY)
	PREPARE MONTHLY REPORTS FOR "RED CROSS"		

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
07. MAINTAIN SAFE ENVIRONMENT	OBSERVE THE SAFETY REGULATIONS OF THE INSTITUTION	USE CORRECT PROCEDURES AND EQUIPMENT FOR SAFE HANDLING OF SPECIMEN	MAINTAIN LABORATORY HYGIENE PRACTICES
	REPORT ACCIDENTS AND PREPARE INCIDENT REPORTS	OPERATE AND MAINTAIN SAFETY EQUIPMENT e.g. EYEBATHS	LABEL HAZARDOUS MATERIALS APPRROPRIATELY
	STORE HAZARDOUS MATERIALS PROPERLY	PERFORM BASIC FIRST AID AND INITIATE C.P.R.	IDENTIFY AND CORRECT HAZARDOUS SITUATIONS
	FOLLOW CORRECT DISPOSAL PROCEDURES	SELECT AND USE CORRECT AGENTS AND PROCEDURES FOR DECONTAMINATION	

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
06. PREPARE LABORATORY MATERIALS	CLEAN AND/OR STERILIZE EQUIPMENT	CALCULATE QUANTITIES USING FORMULAE AND EQUATIONS	MEASURE QUANTITIES USING VOLUMETRIC EQUIPMENT
	MEASURE QUANTITIES USING BALANCES	COMBINE MATERIALS USING APPROPRIATE PROCEDURES AND TECHNIQUES	MEASURE pH (INDICATORS & METERS)
	DISPENSE AND LABEL PREPARED MATERIALS	STORE PREPARED MATERIALS APPROPRIATELY	

GENERAL AREA OF COMPETENCIES	INDIVIDUAL SKILLS		
05. MAINTAIN SUPPLIES	TAKE AND MAINTAIN INVENTORY	CHECK LOT NUMBERS AND EXPIRY DATE REAGENTS	REPORT UNSUITABLE SUPPLIERS TO SUPERVISOR
	RETURN UNSUITABLE SUPPLIES	ROTATE SUPPLIERS	DISPOSE OF OUTDATED STOCK
	PROVIDE SUPPLIERS TO WARD	EXCHANGE SUPPLIES WITH OTHER LABORATORIES	

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
04. OPERATE AND MAINTAIN INSTRUMENTS	PERFORM ROUTINE BASIC MAINTENANCE OF INSTRUMENTS	OPERATE MIXERS	OPERATE DISCRETE ANALYZERS
	OPERATE CONTINUOUS FLOW INSTRUMENTS	OPERATE pH METERS	OPERATE ELECTROPHORETIC INSTRUMENTS
	MONITOR REFRIGERATORS, INCUBATORS AND WATER BATHS	OPERATE LIGHT MICROSCOPES	OPERATE MICROSCOPES
	OPERATE STERILIZING INSTRUMENTS	OPERATE DILUTORS	OPERATE STAINING DEVICES
	OPERATE OSMOMETERS	OPERATE GAS CHROMATOGRAPHS	OPERATE FLUOROMETERS
	OPERATE ATOMIC ABSORPTION INSTRUMENTS	OPERATE BLOOD-GAS INSTRUMENTS	OPERATE CHLORIDOMETERS

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
01. COLLECT SAMPLES	SELECT APPROPRIATE COLLECTION EQUIPMENT	LOCATE PATIENT	EMPLOY ISOLATION TECHNIQUES WHEN NECESSARY
	CONFIRM IDENTITY OF PATIENT	GAIN PATIENT'S PERMISSION	PREPARE PATIENT FOR COLLECTION
	COLLECT SPECIMEN	IDENTIFY SAMPLE	CHECK PATIENT FOR DISTRESS
	INITIATE APPROPRIATE PROCEDURE IF PATIENT IS IN DISTRESS	TRANSPORT SPECIMEN TO LAB	LOG IN SPECIMEN
	PREPARE SPECIMEN FOR BENCH TEST, STORAGE OR REFERRAL	LOG OUT REFERRED SPECIMEN	MAKE SPECIAL SHIPPING ARRANGEMENTS IF NECESSARY

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
02. Perform Laboratory Tests	CHECK SPECIMEN IDENTIFICATION	DECIDE SUITABILITY OF SPECIMEN FOR REQUIRED TEST	SELECT PROCEDURE(S) APPROPRIATE TO SPECIMEN AND TESTS REQUIRED
	ORGANIZE WORKSHEET	ORGANIZE TIME TO SUIT WORKLOAD	PERFORM LABORATORY EVALUATIONS (SEE APPENDICES)
	CONSTRUCT, READ AND INTERPRET GRAPHS AND CHARTS	PERFORM NECESSARY CALCULATIONS	EVALUATE TEST RESULTS
	CORRELATE TEST RESULT WITH PREVIOUS AND OTHER TEST	IDENTIFY ABNORMALITIES AND/OR CONDUCT FOLLOW-UP TESTS	INITIATE APPROPRIATE FOLLOW-UP PROCEDURE
	REPORT RESULTS	RETAIN SPECIMEN FOR CONFIRMATION TESTING OR RETESTING	DISPOSE OF WASTE MATERIALS
	CLEAN-UP WORKSPACE		

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
03. MAINTAIN QUALITY CONTROL	CALIBRATE AND STANDARDIZE EQUIPMENT ON ROUTINE SCHEDULE	MONITOR FUMEHOODS AND SAFETY EQUIPMENT	MONITOR REFRIGERATORS INCUBATORS AND WATER BATHS
	MONITOR EFFICIENCY OF STERILIZATION PROCEDURES	CHECK ALL INCOMING SUPPLIES	TEST ALL INCOMING SUPPLIES
	TEST REAGENTS AND MATERIALS FOR ACCEPTABILITY	RUN CONTROL AND/OR STANDARDS WITH EVERY TEST PERFORMED	RECORD AND EVALUATE QUALITY CONTROL RESULTS
	EVALUATE ASSESSMENT OF EXTERNAL PROFICIENCY TESTING		

GENERAL AREAS OF COMPETENCIES	INDIVIDUAL SKILLS		
04. OPERATE AND MAINTAIN INSTRUMENTS (CON'T)	OPERATE FLAME PHOTOMETERS	OPERATE SPECTROPHOTOMETERS	OPERATE REFRACTOMETERS
	OPERATE HAEMOGLOBINOMETER	OPERATE AUTOMATED CELL COUNTERS	OPERATE AUTOMATIC PLATE POURERS
	OPERATE CELL WASHERS	OPERATE MINI COMPUTERS	USE BENCH AND PROGRAMMABLE CALCULATORS
	OPERATE BALANCES	OPERATE TISSUE PROCESSORS	OPERATE MICROTOME KNIFE SHARPENERS
	OPERATE MICROTOMES	OPERATE CRYOSTATS	OPERATE STILLS AND DE-IONIZERS
	OPERATE AND FUME HOODS	OPERATE AUTOMATIC GLASSWARE WASHER	IDENTIFY INSTRUMENT PROBLEMS

APPENDIX C

NORTHERN ALBERTA INSTITUTE OF TECHNOLOGY
DACUM CHART
MEDICAL LABORATORY PROGRAM

GENERAL AREAS OF COMPETENCE

A. Communicate effectivelv in the work environment

B. Apply laboratory safety and emergency procedures

C. Prepare reagents and standards

D. Collect and prepare specimens

E. Report and maintain records

F. Maintain quality control

G. Perform manual techniques

H. Perform automated techniques

I. Maintain and troubleshoot equipment and instruments

J. Supervise, administer, and organize

K. Perform specialized techniques

GENERAL AREA OF COMPETENCE

A. COMMUNICATE EFFECTIVELY IN THE WORK ENVIRONMENT

INDIVIDUAL SKILLS

1. Write legibly
2. Work as part of a team
3. Accept constructive criticism
4. Deal professionally with patients
5. Use technical terminology
6. Use proper telephone and intercome techniques
7. Write letters
8. Use medical terminology
9. Utilize medical and technical research facilities (i.e. library)
10. Maintain liaison with other hospital departments
11. Request and obtain information and decisions
12. Participate in seminars and workshops
13. Present reports, evaluations, and problems at meetings
14. Recognize and question unreasonable orders
15. Explain why lab cannot comply with requests
16. Explain lab policies, procedures or changes
17. Give clear work instructions
18. Give constructive criticism
19. Advise and educate hospital staff on laboratory utilization
20. Organize and conduct meetings
21. Conduct seminars and lectures
22. Maintain and distribute minutes of meetings
23. Compile and maintain laboratory and ward manuals
24. Reason with administration

GENERAL AREA OF COMPETENCE

B. APPLY LAB. SAFETY AND EMERGENCY PROCEDURES

INDIVIDUAL SKILLS

1. Clean up non hazardous spills
2. Recognize need for and use protective clothing and equipment
3. Observe health, safety, and fire regulations
4. Replace damaged or soiled requisitions
5. Double-check labelling before using reagents
6. Recognize need for and use fume hood
7. Recognize potential physical hazards in lab
8. Use open flames
9. Locate all emergency equipment
10. Prevent aerosols
11. Handle microtome knives
12. Maintain clean and orderly work and storage areas
13. Clean up and dispose of broken glassware and shards
14. Handle and dispose of specimens and reagents
15. Handle and dispose of contaminated materials
16. Disinfect work areas and equipment
17. Label hazardous material using appropriate symbols
18. Operate emergency showers and eye wash
19. Use fire blanket
20. Use suitable fire extinguishers
21. Mix potentially dangerous reagents and chemicals
22. Recognize, handle, and store flammable liquids
23. Recognize, store, and handle dangerous acids and alkalis
24. Recognize, store, and control hazardous drugs and narcotics
25. Recognize, handle, and store explosives
26. Recognize, store, and handle carcinogens
27. Handle, store, and dispose of gas cylinders
28. Handle ultra cold material
29. Follow lab accident procedures
30. Apply first aid
31. Function in emergency situations in all departments
32. Recognize high risk areas
33. Recognize hazardous conditions in electrical equipment
34. Designate high risk areas and materials
35. Protect self from radiation
36. Monitor bench areas for radioactivity
37. Dispose of radioactive materials to gov't specifications
38. Monitor personnel for radioactivity

GENERAL AREA OF COMPETENCE

C. PREPARE REAGENTS AND STANDARDS

INDIVIDUAL SKILLS

1. Label
2. Select appropriate containers
3. Follow recipes and instructions
4. Clean glassware
5. Mix
6. Filter
7. Measure by volume
8. Use top-loading balance
9. Use analytical balance
10. Prepare dilutions
11. Operate pH meters
12. Titrate
13. Use heat correctly
14. Calculate and use appropriate formulae
15. Store reagents and standards
16. Grind with mortar and pestle
17. Sterilize
18. Check and discard outdated reagents and chemical
19. Select reagent quality according to method requirements
20. Check out prepared reagents
21. Dessicate reagents
22. Calibrate secondary standards vs primary standards
23. Calibrate volumetric glassware
24. Check conductivity of water
25. Purify water by distillation, filtration, and deionization
26. Establish and maintain log of reagents prepared

GENERAL AREA OF COMPETENCE

D. COLLECT AND PREPARE SPECIMENS

INDIVIDUAL SKILLS

1. Label specimens
2. Protect self and patient by using isolation techniques
3. Follow aseptic technique
4. Follow patient identification procedures
5. Reassure patients
6. Select proper containers for specimen collection
7. Choose and prepare site for specimen collection
8. Choose proper needle gauge
9. Perform venipunctures using vacuum tubes
10. Collect specimens in proper sequence
11. Perform venipunctures using syringe
12. Perform double syringe technique
13. Collect capillary specimens
14. Match and number tubes and requisitions
15. Prepare and cover slip films
16. Handle and transport specimens
17. Prepare urine sediment for microscopic examination
18. Centrifuge and aliquot specimens
19. Decontaminate specimen containers
20. Balance and operate centrifuge
21. Mix, measure volume, and aliquot specimens
22. Defibrinate blood
23. Mix, weigh, and aliquot specimens
24. Recognize and report insufficient specimen or improper collection
25. Recognize specimen type
26. Determine appropriate amount of specimen required for test
27. Maintain accession and filing system
28. Recognize normal and abnormal specimens (i.e. appearance)
29. Store specimens
30. Record, pack, and ship out specimens
31. Prepare specimen containers for special collections
32. Use butterfly technique
33. Prepare blood films

GENERAL AREA OF COMPETENCE

E. REPORT AND MAINTAIN RECORDS

INDIVIDUAL SKILLS

1. Write legibly
2. Control confidentiality of reports and reporting
3. Maintain accession system
4. Maintain accurate log of referred-out specimens and results
5. Maintain daily working records
6. Identify normal results
7. Report values in terms of concentration
8. Enter relevant information on reports
9. Report reference values
10. Complete requisitions
11. Provide oral explanations of results
12. Recognize errors in reporting
13. Detect procedure errors from test results
14. Recognize abnormal results
15. Recognize and investigate abnormal change in patient results
16. Relate results to clinical conditions
17. Relate results to patient history
18. Recognize needs and give preliminary reports
19. Dispatch report copies
20. Recognize and act on panic values
21. Explain why it is known that test results are correct
22. Report and receive explanations on telephone
23. Provide written explanations of results
24. Assess compatibility of results of different tests
25. Suggest possible follow-up procedures
26. Maintain follow-up on delayed values
27. Maintain filing system
28. Check reported values
29. Maintain unit values system
30. Maintain proper long term storage of lab records
31. Design and update requisition and report forms
32. Initiate and verify fee changes

GENERAL AREA OF COMPETENCE

F. MAINTAIN QUALITY CONTROL

INDIVIDUAL SKILLS

1. Read and follow instructions exactly
2. Examine glassware for cleanliness and suitability
3. Prepare standards, controls, and reagents
4. Assure integrity of specimens, controls, and reagents
5. Store reagents, specimens, standards, and quality control materials
6. Calculate mean and standard deviation
7. Recognize need for repeating tests
8. Establish reference values
9. Establish stability of standards, controls, and reagents
10. Recognize variables in tests in order to select controls
11. Compile cumulative data
12. Perform and record regular calibration checks on equipment
13. Maintain regular observation checks during equipment operation and use
14. Decide if results are reportable
15. Assess variables and determine frequency of controls
16. Perform sterility checks
17. Institute double-checking procedures
18. Use patient records as quality control indicator
19. Determine allowable limits of error
20. Recognize random errors
21. Locate random errors
22. Recognize systematic errors
23. Locate systematic errors
24. Record systematic errors
25. Check on accuracy and reproducibility of tests and controls
26. Evaluate accuracy and precision of method
27. Maintain equipment inventory
28. Interpret quality control results
29. Carry out recovery experiments
30. Co-ordinate quality control
31. Set up quality control program and manual
32. Select appropriate statistical tools
33. Prepare and maintain methods manual
34. Prepare and update maintenance manuals
35. Investigate methodological problems
36. Demonstrate unusual techniques and non typical specimens
37. Maintain specimen library

GENERAL AREA OF COMPETENCE

G. PERFORM MANUAL TECHNIQUES

INDIVIDUAL SKILLS

1. Use timing devices
2. Follow instructions exactly
3. Use Pasteur pipettes
4. Use serological pipettes
5. Use magnifying lens
6. Use volumetric pipettes
7. Use Thoma pipette
8. Use Sahli pipette
9. Use capillary pipettes
10. Choose appropriate pipettes
11. Dilute specimens
12. Decant
13. Operate dilutors
14. Read thermometers
15. Use pH indicator paper
16. Make and fix smears on glass slides
17. Select and use heating and incubating equipment
18. Select and use cooling equipment
19. Select and use mixing equipment
20. Select and use hydrometers
21. Select and use centrifuge
22. Use the cytospin
23. Operate a spectrophotometer
24. Select and use proper glassware
25. Select, use, and care for cuvettes
26. Concentrate specimens
27. Perform serial dilutions
28. Select and use filtration equipment
29. Draw calibration curves & calculate unknowns
30. Use polarizing microscope
31. Select appropriate control slides
32. Recognize problems when they occur
33. Use Gram's stain
34. Screen nasal smears for eosinophils
35. Use Z-N stain
36. Select appropriate reagents
37. Perform hemosiderin stain
38. Choose appropriate diluting fluid
39. Read and grade agglutination
40. Use stereoscopic microscope
41. Perform agglutination techniques
42. Operate refractometer
43. Use light microscope
44. Combine simple skills to perform more complex methods
45. Use fluorescent microscope
46. Use darkfield microscope
47. Use phase contrast microscope
48. Operate spectroscope
49. Select and use distillation equipment
50. Perform extraction procedures
51. Perform end point reactions
52. Select and use indicators for end point titration
53. Perform plasma hemoglobin tests
54. Stain and verify histochemical procedures (e.g. P.A.S.)
55. Perform special stains (Sudan Black, NSE, B-Glucutonidase, acid phos., myeloperoxide, ... malaria)
56. Perform agar electrophoresis
57. Prepare electrophoresis media
58. Recognize need for further testing
59. Recognize possible causes of false positive and false negative results
60. Perform functional tests on patients

GENERAL AREA OF COMPETENCE

H. PERFORM AUTOMATED TECHNIQUES

INDIVIDUAL SKILLS

1. Operate automatic burettes
2. Operate automatic pipetters
3. Operate automatic dispensers
4. Log data from digital readouts
5. Operate semi-automatic titrators
6. Operate continuous flow instruments
7. Identify, read, and log peaks on recorder
8. Operate discrete analyzers
9. Operate recording spectronhotometer
10. Operate densitometers
11. Prepare specimens in sequence
12. Use computer facilities
13. Operate automated slide makers
14. Operate automated R.I.A. systems
15. Operate small computers

GENERAL AREA OF COMPETENCE

I. MAINTAIN AND TROUBLESHOOT EQUIPMENT AND INSTRUMENTS

INDIVIDUAL SKILLS

1. Follow manufacturer's instructions for maintenance
2. Wash glassware according to method requirements
3. Log equipment maintenance
4. Keep instruments and equipment clean
5. Check and change dessicants
6. Match cuvettes
7. Check and clean glass pipettes
8. Check calibration of balances
9. Check and clean filters
10. Replace light sources
11. Replace gas cylinders
12. Check and change deionizing resins
13. Maintain heating and cooling baths
14. Check and adjust temperature regulating equipment
15. Check and/or change centrifuge brushes
16. Check calibration of manual pipettes
17. Maintain automatic pipetters
18. Maintain automatic dilutors
19. Calibrate automatic pipetters
20. Calibrate dilutors
21. Calibrate burettes
22. Clean water stills
23. Check calibration of timing devices
24. Determine and adjust aspiration rate
25. Clean and/or replace tubing
26. Maintain slide stainers
27. Adjust and maintain automated cell washers
28. Clean andservice air compression and vacuum pumps
29. Maintain constant monitoring devices of refrigerators and freezers
30. Maintain automated slide maker
31. Change dialysis membranes
32. Lubricate pumps, motors, and other moving parts
33. Clean and service pumps on pipetting station
34. Replace valves, and other parts in equipment
35. Perform electronic checks
36. Check and calibrate refractometers
37. Monitor background counts on counters (cell & isotope)
38. Calibrate colorimeters
39. Calibrate spectrophotometers
40. Calibrate strip chart recorders
41. Calibrate densitometers
42. Check and adjust wavelengths
43. Adjust calibration of balances
44. Establish threshold curve for calibration of counters (cell & isotope)
45. Check calibration of counters
46. Follow manufacturer's trouble-shooting guides

GENERAL AREA OF COMPETENCE

J. SUPERVISE, ADMINISTER, AND ORGANIZE

INDIVIDUAL SKILLS

1. Keep time sheets
2. Accept responsibility
3. Make up work schedules
4. Demonstrate efficient performance
5. Demonstrate methods
6. Assign tasks
7. Delegate authority
8. Orient new staff
9. Recognize and deal with personnel problems
10. Discipline staff
11. Evaluate staff members
12. Initiate disciplinary action
13. Verify and sign completed reports
14. Organize bench work for efficiency
15. Keep orderly log on procedure development
16. Compile hospital units and statistics
17. Budget efficiently
18. Review literature to evaluate new equipment and materials
19. Maintain quality control systems
20. Maintain record systems
21. Order supplies
22. Maintain personnel records
23. Develop inventory systems
24. Maintain inventories
25. Maintain equipment inventory
26. Prepare preventative maintenance program
27. Maintain preventive maintenance program
28. Establish criteria for introducing new methods
29. Recognize possibility of modifying existing methods
30. Recognize need to discontinue obsolete methods
31. Recognize need for new method
32. Evaluate and select new instruments and equipment
33. Accept or reject method under investigation
34. Perform follow-up evaluations of newly introduced methods
35. Conduct meetings
36. Liaise with other departments
37. Give lectures and seminars
38. Enforce staff health, fire and safety reggulations and procedures
39. Interview and select staff
40. Write and/or review job descriptions
41. Set objectives
42. Establish lab policies
43. Negotiate sales and service contracts
44. Prepare budgets
45. Negotiate wages and service contracts
46. Operate within labour relations codes and union contracts
47. Establish unit values for tests
48. Initiate corrective action for lab and reporting errors
49. Analyze lab utilization and point out suspected abuses
50. Develop Q.C. programs
51. Design evaluation studies
52. Establish training and continuing education programs
53. Monitor training programs
54. Assist in design of computer programs
55. Assist in designing lab layout or alterations
56. Establish clinical applications of tests
57. Organize laboratory to conform to disaster plan
58. Keep orderly log of procedure development
59. Recognize possibility of modifying existing methods

GENERAL AREA OF COMPETENCE

K. PERFORM SPECIALIZED TECHNIQUES

INDIVIDUAL SKILLS

1. Write computer programs
2. Maintain electron microscope
3. Use electron microscope
4. Utilize lab animals
5. Handle lab animals
6. Interpret test results (i.e. clinical significance)

APPENDIX D

NEEDS ASSESSMENT SURVEY

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

The C.S.L.T. Certification Board, with the approval of the Board of Directors, has commissioned the validation of the Syllabus of Studies for initial R.T. (General) certification. This validation will form part of a larger project, a M.Ed. Thesis, entitled "Evaluation of the National Certification Program for Medical Laboratory Technologists in Canada".

As a program head, you have pertinent first-hand information on the existing training programs. Therefore, we request that you complete the attached questionnaire as accurately, honestly and quickly as possible and return it in the enclosed envelope before December 14, 1984. If you have additional comments or information which you feel would be useful in this project, please feel free to include it with the completed questionnaire.

In order to accurately complete this phase of the project, it is essential that we hear from all the training programs in Canada. This is your opportunity as an educator and professional to participate in the future direction of the certification process and the professional organization.

All participants will receive a copy of the summary of the findings so that they can continue to be adequately informed of the educational requirements/regulations across Canada.

We thank you for your assistance and continued support of the C.S.L.T. and its endeavours.

S Beckman	Sister Dorothy Ryan	K. Puffer
Shirley Beckman President C.S.L.T.	Sister Dorothy Ryan Validation Co-ordinator Past President, C.S.L.T.	Dr. K. Puffer, Ph.D. Chairman Thesis Committee

Attch.
/ap

P.O. C.P. 830 Hamilton Ontario L8N 3N8 (416) 528-8642

TRAINING PROGRAM QUESTIONNAIRE

The attached questionnaire has been designed to solicit pertinent information on admission requirements/regulations and program structure from the training programs in medical laboratory technology across Canada.

In using this information, the author will ensure confidentiality to the respondent and to the institution.

Sister Dorothy Ryan
Sister Dorothy Ryan
Validation Co-ordinator

K. Puffer
Dr. K. Puffer, Ph.D.
Chairman, Thesis Committee

attach.

A. GENERAL INFORMATION:

1. Name of institution: ______________________________

____

2. Name of respondent: ______________________________
(for follow up
purposes)

B. ADMISSION REQUIREMENTS:

1. Admission to program from high school:
   a) grade 11 ________
   b) grade 12 ________
   c) grade 13 ________
2. Check (✓) required subjects at above level:
   a) Chemistry ________
   b) Physics ________
   c) Biology ________
   d) Mathematics ________
   e) English ________
   f) Other (specify) ________
3. Minimum average required in high school subjects:
   a) per subject ________
   b) overall ________
4. Mean high school average of successful applicants:
   a) 1984-85: ________
   b) 1983-84: ________
   c) 1982-83: ________
5. Length of training program (including clinical training):
   a) two years ________
   b) three years ________
6. Check (✓) if you require for admission:
   ____________ personal interview
   ____________ references
   ____________ letter of interest/personal objectives
   ____________ medical examination
7. Additional admission requirements:

____

____

____

____

C. PROGRAM STRUCTURE:

Didactic Segment:

1. Length of didactic training: _______________ (number of months)

   If answer is TWO YEARS, what percentage (%) of the first year would be considered DIRECTLY related to medical laboratory technology:

   a) less than 25% _______ c) 50% to 75% _______

   b) 25% to 50% _______ d) over 75% _______

2. Do you and your staff feel that this is sufficient time to adequately teach the core content required by the Syllabus of Studies:

   a) Yes _______

   b) No _______

   If NO, what would be your suggestions for change:

   ____

   ____

   ____

   ____

   ____

   ____

Clinical Segment:

1. Length of clinical training: _______ months

2. Structure: _______ "hands on" system

   _______ simulated system

3. Do you and your staff feel this is sufficient time to adequately teach practical competencies:

   a) Yes _______

   b) No _______

   If NO, what changes should be made:

   ____

   ____

   ____

   ____

4. What skills are best learned in the clinical laboratory environment?

____

____

____

____

____

____

____

D. SUMMARY: (PROGRAM STRUCTURE):

1. Is there sufficient time to teach/learn the core content in:
   a) didactic segment __________
   b) clinical segment __________
   c) total program __________

2. Is there sufficient time to teach/learn the practical competencies in:
   a) didactic segment __________
   b) clinical segment __________
   c) total program __________

3. Are you dissatisfied with any particular discipline (in general) in the Syllabus of Studies? If so, which one ____________________.

E. VALIDATION OF SYLLABUS:

1. Does the Syllabus of Studies contain the theory, competencies and/or essential skills required by the new graduate?

   a) Yes ________

   b) No ________

   If NO, what additional skills should be included?

   ____

   ____

   ____

   ____

2. Does the Syllabus of Studies contain theory, competencies and/or skills that are not essential/required by the new graduate?

   a) Yes ________

   b) No ________

   If YES, specify those areas that are not required by the new graduate and that should be removed from the general Syllabus of Studies.

   ____

   ____

   ____

   ____

3. Does the Syllabus of Studies contain theory, competencies and/or skills that should be reserved to an advanced level of certification?

   a) Yes ________

   b) No ________

   If YES, specify those areas that should be removed from the general Syllabus of Studies.

   ____

   ____

   ____

   ____

4. Do the C.S.L.T. examinations adequately reflect the:

   a) Syllabus of Studies ________

   b) needs of the new graduate ________

5. Other information/comments:

   ____

   ____

   ____

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

Le 30 novembre 1984

La Commission de certification de l'A.C.T.L., avec l'approbation du Conseil d'administration, a commissionné la validation du Syllabus d'études pour le diplôme R.T. général initial. Cette validation fera partie d'un plus grand projet, soit une thèse de maîtrise en Éducation, intitulée "Evaluation of the National Certification Program for Medical Laboratory Technologists in Canada".

En tant que coordonnateur de programme, vous possédez d'importants renseignements de première-main au sujet des programmes de formation disponibles à l'heure actuelle. C'est pourquoi nous vous demandons de bien vouloir remplir le questionnaire ci-joint le plus précisément, honnêtement et rapidement possible et de nous le retourner dans l'enveloppe ci-incluse avant le 21 décembre. Si vous désirez ajouter quelques commentaires ou renseignements que vous jugez utiles dans le cadre de ce projet, n'hésitez pas à nous les faire parvenir avec le questionnaire dûment rempli.

Il est essentiel, pour mener à bien cette phase du projet, que tous les coordonnateurs de programmes de formation au Canada nous envoient leur réponse. En tant d'éducateur et professionnel, vous ne devez pas laisser passer cette occasion de prendre part à la direction future du processus de certification et de l'organisation professionnelle.

Tous les participants recevront un aperçu des conclusions, les mettant au courant des exigences et règlements mis en pratique dans le domaine de l'enseignement au Canada.

Nous vous remercions de votre collaboration et de votre appui continuel à l'égard de l'A.C.T.L. et de ses entreprises.

S Beckman	Sister Dorothy Ryan	K. Puffer
Shirley Beckman Présidente de l'A.C.T.L.	Soeur Dorothy Ryan Coordonnatrice de la validation Présidente sortant de charge	Dr. K. Puffer, Ph.D. Président du Comité de thèse

/fp

C P 830, Hamilton Ontario L8N 3N8 (416) 528-8642

QUESTIONNAIRE CONCERNANT LE PROGRAMME DE FORMATION

Le questionnaire ci-joint a été conçu dans le but d'obtenir, de la part des coordonnateurs de programmes de formation en technologie de laboratoire médical à travers le Canada, une quantité de renseignements utiles concernant les conditions et les règlements d'admission ainsi que la structure des programmes.

L'auteur garantit au répondant et à l'institution que tous les renseignements contenus dans ce questionnaire resteront confidentiels.

Sister Dorothy Ryan
Soeur Dorothy Ryan
Coordonnatrice de la validation

K. Puffer
Dr. K. Puffer, Ph.D.
Président, Comité de thèse

Pièce jointe

A

A. RENSEIGNEMENTS GÉNÉRAUX:

1. Nom de l'institution: ______________________________

____

2. Nom du répondant: ______________________________
(pour donner suite
au questionnaire)

B. CONDITIONS D'ADMISSION:

1. Admission au programme à la fin du secondaire:
   - a) 11e année ______
   - b) 12e année ______
   - c) 13e année ______
2. Cochez (✓) les matières obligatoires au niveau cité plus haut:
   - a) Chimie ______
   - b) Physique ______
   - c) Biologie ______
   - d) Mathématiques ______
   - e) Anglais ______
   - f) Autre (spécifiez) ______
3. Moyenne minimum exigée pour les matières enseignées au secondaire:
   - a) pour chaque matière ______
   - b) moyenne générale ______
4. Moyenne générale au secondaire des candidats choisis:
   - a) 1984-85: ______
   - b) 1983-84: ______
   - c) 1982-83: ______
5. Durée du programme de formation (y compris la formation clinique):
   - a) deux ans ______
   - b) trois ans ______
6. Cochez (✓) si requis au moment de l'admission:
   - ______ entrevue personnelle
   - ______ références
   - ______ lettre décrivant intérêts et objectifs personnels
   - ______ examen médical
7. Conditions d'admission supplémentaires:

____

____

____

____

C. STRUCTURE DU PROGRAMME:

Partie didactique:

1. Durée de la formation didactique: ____________ (nombre de mois).

   Si la durée est de DEUX ANS, quel pourcentage (%) de la première année serait considérée comme DIRECTEMENT reliée à la technologie de laboratoire médical:

   a) moins de 25% ________

   b) 25% à 50% ________

   c) 50% à 75% ________

   d) plus de 75% ________

2. Selon vous et votre personnel, est-ce assez de temps pour enseigner de manière adéquate la matière de base exigée par le Syllabus d'études:

   a) Oui ________

   b) Non ________

   Si NON, quels changements suggérez-vous?

   ____

   ____

   ____

   ____

   ____

   ____

Partie clinique:

1. Durée de la formation clinique: _________ mois.

2. Structure: ________ système basé sur l'expérience pratique

   ________ système basé sur la simulation

3. Selon vous et votre personnel, est-ce assez de temps pour enseigner de manière adéquate des compétences d'ordre pratique:

   a) Oui ________

   b) Non ________

   Si NON, quels changements suggérez-vous?

   ____

   ____

   ____

   ____

4. Quelles compétences sont plus facilement apprises dans le contexte du laboratoire clinique?

____

____

____

____

____

____

____

D. RÉSUMÉ: (STRUCTURE DU PROGRAMME):

1. Y a-t-il suffisamment de temps pour enseigner/apprendre la matière de base durant la période consacrée à:

   a) la partie didactique ________

   b) la partie clinique ________

   c) la totalité du programme ________

2. Y a-t-il suffisamment de temps pour enseigner/apprendre les compétences d'ordre pratique durant la période consacrée à:

   a) la partie didactique ________

   b) la partie clinique ________

   c) la totalité du programme ________

3. Êtes-vous satisfait, en général, du choix des disciplines incluses dans le Syllabus d'études. Si non, spécifiez: ______________________

   ____.

E. VALIDATION DU SYLLABUS:

1. Le Syllabus d'études contient-il la théorie et les compétences essentielles ou nécessaires au nouveau diplômé?

   a) Oui ________

   b) Non ________

   Si NON, quelles compétences supplémentaires devrait-on ajouter?

   ____

   ____

   ____

   ____

2. Le Syllabus d'études contient-il de la théorie et des compétences qui ne seraient pas essentielles ou nécessaires au nouveau diplômé?

   a) Oui ________

   b) Non ________

   Si OUI, spécifiez les domaines qui ne sont pas nécessaires au nouveau diplômé et qui devraient être retirés du Syllabus d'études général.

   ____

   ____

   ____

   ____

3. Le Syllabus d'études contient-il de la théorie et des compétences qui relèvent d'un niveau de certification avancé?

   a) Oui ________

   b) Non ________

   Si OUI, spécifiez les domaines qui devraient être retirés du Syllabus d'études général.

   ____

   ____

   ____

   ____

4. Les examens de l'A.C.T.L. reflètent-ils de façon adéquate:

   a) le Syllabus d'études ________

   b) les besoins du nouveau diplômé ________

5. Autres renseignements ou commentaires:

   ____

   ____

   ____

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

January 18, 1985

In December 1984, the C.S.L.T distributed a Training Program Questionnaire to the heads of all medical laboratory training programs in Canada as part of the Syllabus of Studies validation process. The responses from this questionnaire are to provide background information for the study and follow-up questions for inclusion in the subsequent student and employer surveys.

To date, 16 (51.6%) of the questionnaires have been completed and returned. The tabulated responses are quite informative and should provide excellent follow-up material. However, any conclusions may be suspect due to the low percentage of return.

Since I have not received a response from your institution, I am enclosing a second questionnaire for your use. I would ask you to return the completed questionnaire to me no later than February 6th, 1985.

It is important that we hear from you so that our information is truly representative of all regions and all programs in Canada.

Thank you for your assistance in this matter.

Sincerely,

Sister Dorothy Ryan

Sister Dorothy Ryan
Validation Co-ordinator

RETURN ADDRESS: Sister Dorothy Ryan
Medical Laboratory Science
B-117 Clinical Sciences Building
University of Alberta
T6G 3E8

Encl.

/ld

P.O./C.P. 830, Hamilton, Ontario L8N 3N8 (416) 528-8642

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

le 18 janvier 1985

En décembre 1984, l'A.C.T.L. a distribué un questionnaire concernant les programmes de formation, à tous les directeurs canadiens de programmes de formation en techniques de laboratoire médical; ce questionnaire fait partie du processus de validation des syllabus d'études. Les réponses doivent servir d'élément de base à des fins d'études et comme questions complémentaires à inclure dans les futures enquêtes auprès des étudiants et employeurs.

À date, 16 (51.6%) questionnaires ont été complétés et retournés. Les réponses classifiées sont très utiles au niveau de l'information et pourraient fournir un excellent matériel complémentaire. Cependant toute conclusion semble incertaine en raison du faible pourcentage de réponses.

N'ayant pas reçu de réponse de votre institution, je vous fais parvenir un second questionnaire et vous demanderais de bien vouloir me le retourner dûment complété au plus tard le 10 février 1985.

Votre participation est essentielle afin que cette information soit vraiment représentative de tous les programmes et de toutes les régions à travers le Canada.

Je vous remercie de votre collaboration.

Sincèrement,

Sister Dorothy Ryan

Soeur Dorothy Ryan
Coordinatrice du programme de validation

ADDRESSE DE RETOUR: Soeur Dorothy Ryan
Medical Laboratory Science
B-117 Clinical Sciences Building
University of Alberta
T6G 3E8

Annexe
/lm

P.O./C.P. 830, Hamilton, Ontario L8N 3N8 (416) 528-8642

APPENDIX E

FOLLOW-UP SURVEY

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

Dear Graduate,

The C.S.L.T. is conducting a validation survey to determine to what extent the R.T. (General) Syllabus reflects the actual needs of the employer and the technologist in the work place. As a recent graduate from an approved training program, we are requesting your assistance in this project.

Please complete this questionnaire as outlined in the following instruction page, and return it in the enclosed stamped envelope before . All respondents will be eligible for one of five GRAND PRIZES - free C.S.L.T. membership for 1986 (valued at $88.00).

This is your opportunity to influence the certification process and to assist in the next revision of the Syllabus of Studies. Your personal participation is essential for the success of this project.

Thank you for your time and honest response.

Norman Senn President C.S.L.T.	Sister Dorothy Ryan Validation Co-ordinator	Dr. K. Puffer, Ph.D. Chairman Thesis Committee

P.O./C.P. 830, Hamilton, Ontario L8N 3N8 (416) 528-8642

INSTRUCTIONS

The main purpose of this graduate survey is to validate the C.S.L.T. Syllabus of Studies in the work place to see if it meets the needs of the new graduate.

You do not need the Syllabus to complete the questionnaire since the level of detail, the categories and the wording of the questions are taken directly from the student requirements of the Syllabus. Please answer the questions regarding the Syllabus and the examinations AS YOU CAN RECALL YOUR TRAINING.

You are not required to complete the entire survey. The following detailed instructions are to assist you with the questionnaire:

SECTION 1:GENERAL INFORMATION	to be completed by ALL respondents.
SECTION 2: GENERAL KNOWLEDGE	to be completed by ALL respondents.
SECTIONS 3-7: INDIVIDUAL DISCIPLINES	complete only those sections that you work in at least 30% of the time. In other words, the most that you should complete is 3 sections in this part.

EXAMPLE: If you work exclusively in Clinical Chemistry, complete Section 6 only.

If you are a general duty technologist and work in all areas, complete the 3 Sections that you work in the most.

If you are not working and have not worked during the past year, please return the questionnaire UNANSWERED as you will not be able to respond adequately to the needs of the work place.

PROCEED TO SECTION 1 ➡

THANK YOU

SECTION 1: GENERAL INFORMATION

A. PERSONAL DATA

1. Date you obtained R.T.: 1982 ☐ 1983 ☐ 1984 ☐

2. Sex: Male ☐ Female ☐

3. Language of choice: Francophone ☐ Anglophone ☐ Bilingual ☐

4. Length of training program (including clinical training):
   - a) ☐ two years
   - b) ☐ three years
   - c) ☐ four years

5. Present employer:
   - a) ☐ hospital
   - b) ☐ private lab.
   - c) ☐ Red Cross
   - d) ☐ govt. lab
   - e) ☐ other (specify) ____________

6. Total number of technologists working in the entire laboratory where you are presently employed ?
   - a) ☐ < 10
   - b) ☐ 10 - 20
   - c) ☐ 21 - 50
   - d) ☐ 51 - 100
   - e) ☐ > 100

7. Present location: ____________________ (Province)

B. SUMMARY OF TRAINING

1. Check (√) those disciplines that you feel were adequately covered in your training program to meet your needs in the work place:
   - a) ☐ Clinical Chemistry
   - b) ☐ Hematology
   - c) ☐ Histotechnology
   - d) ☐ Immunohematology
   - e) ☐ Clinical Microbiology

2. Check (√) those disciplines that you feel should continue to be included in the general R.T. certification program:
   - a) ☐ Clinical Chemistry
   - b) ☐ Hematology
   - c) ☐ Histotechnology
   - d) ☐ Immunohematology
   - e) ☐ Clinical Microbiology

OVER ➔

3. Was there sufficient time to learn the practical skills in:

a) theoretical segment: YES ☐ NO ☐
b) practical segment : YES ☐ NO ☐
c) total program : YES ☐ NO ☐

4. Was there sufficient time to learn the essential theoretical knowledge in:

a) theoretical segment: YES ☐ NO ☐
b) practical segment : YES ☐ NO ☐
c) total program : YES ☐ NO ☐

5. Does the Syllabus of Studies contain the theory and/or essential skills required by the NEW graduate ?

a) ☐ YES
b) ☐ NO

If NO, what additional skills should be included ?

____
____
____

6. Does the Syllabus of Studies contain theory and/or skills that are not essential/required by the NEW graduate ?

a) ☐ YES
b) ☐ NO

If YES, specify those areas that are not required by the NEW graduate and that should be removed from the Syllabus

____
____
____

7. Do the C.S.L.T. examinations cover the material :

a) in Syllabus of Studies: YES ☐ NO ☐
b) needed by the NEW graduate: YES ☐ NO ☐

COMMENTS: ______________________________
____
____
____

8. Estimate the amount of time (in %) that you have spent working in each area during the past 1-2 years of employment:

a) _____ % Clinical Chemistry
b) _____ % Hematology
c) _____ % Histotechnology
d) _____ % Immunohematology
e) _____ % Microbiology

PROCEED TO SECTION 2 ➳

SECTION 2: GENERAL KNOWLEDGE

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY ALL RESPONDENTS.

A. For each item below, check (✓) the appropriate responses

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Human anatomy and physiology	☐	☐	○	○	☐	☐	☐	○	○	○
2. General genetics	☐	☐	○	○	☐	☐	☐	○	○	○
3. Molecular biology	☐	☐	○	○	☐	☐	☐	○	○	○
4. Basic concepts of immunity	☐	☐	○	○	☐	☐	☐	○	○	○
5. Introductory inorganic chemistry	☐	☐	○	○	☐	☐	☐	○	○	○
6. Introductory organic chemistry	☐	☐	○	○	☐	☐	☐	○	○	○
7. Basic physics	☐	☐	○	○	☐	☐	☐	○	○	○
8. Lab. mathematics & statistics	☐	☐	○	○	☐	☐	☐	○	○	○
9. Laboratory safety	☐	☐	○	○	☐	☐	☐	○	○	○
10. Laboratory glass & plastic ware	☐	☐	○	○	☐	☐	☐	○	○	○
11. Sterilization & disinfection	☐	☐	○	○	☐	☐	☐	○	○	○
12. Collection of specimens	☐	☐	○	○	☐	☐	☐	○	○	○
13. Laboratory records	☐	☐	○	○	☐	☐	☐	○	○	○
14. Legal aspects & the technologist	☐	☐	○	○	☐	☐	☐	○	○	○
15. Basic laboratory instrumentation	☐	☐	○	○	☐	☐	☐	○	○	○
16. Preventive maintenance	☐	☐	○	○	☐	☐	☐	○	○	○
17. Communications	☐	☐	○	○	☐	☐	☐	○	○	○

B. Additional comments on general knowledge section:

PROCEED TO SECTION 3 ➡

SECTION 5: IMMUNOHEMATOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN IMMUNOHEMATOLOGY AT LEAST 30% OF THE TIME.
IF YOU DO NOT WORK IN IMMUNOHEMATOLOGY AT LEAST 30% OF THE TIME, MOVE ON TO SECTION 4. ⟶

A. For each item below, check (✓) the appropriate answers

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CELT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Factors affecting antigen-antibody reactions	☐	☐	○	○	☐	☐	☐	○	○	○
2. Inhibition/neutralization tests	☐	☐	○	○	☐	☐	☐	○	○	○
3. REAGENTS: origin, storage and ...										
a) cell suspension: preparation	☐	☐	○	○	☐	☐	☐	○	○	○
b) Rh-hr control: use	☐	☐	○	○	☐	☐	☐	○	○	○
c) Antisera: govt. regulations	☐	☐	○	○	☐	☐	☐	○	○	○
d) Bovine albumin	☐	☐	○	○	☐	☐	☐	○	○	○
e) Saline sol'n: prep., constituents	☐	☐	○	○	☐	☐	☐	○	○	○
f) Proteolytic enzymes	☐	☐	○	○	☐	☐	☐	○	○	○
4. Specificity of lectins	☐	☐	○	○	☐	☐	☐	○	○	○
5. EQUIPMENT: use & application:										
a) refrigerated centrifuge	☐	☐	○	○	☐	☐	☐	○	○	○
b) blood bank refrigerator	☐	☐	○	○	☐	☐	☐	○	○	○
c) Rh viewing box	☐	☐	○	○	☐	☐	☐	○	○	○
6. BLOOD DONATION:										
a) criteria for selection of donors	☐	☐	○	○	☐	☐	☐	○	○	○
b) procedure for collection:	☐	☐	○	○	☐	☐	☐	○	○	○
c) tests done on donated blood	☐	☐	○	○	☐	☐	☐	○	○	○
d) blood components: storage and effect of storage	☐	☐	○	○	☐	☐	☐	○	○	○

B. For each blood group system below, indicate (✓) those items that you feel are necessary to work effectively in Immunohematology

ITEM	Characteristics of antigens	Characteristics of antibodies	Clinical sign. of antibodies	Nomenclature	Frequency of Phenotypes	Phenotyping Procedures	Interpretation of Phenotyping Results	Use of appropriate Controls	Causes of Anomalous Results
1. ABO System	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. LEWIS System	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. RHESUS System	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. P System	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. I System	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. MNSs System	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. DUFFY System	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. KELL System	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. KIDD System	☐	☐	☐	☐	☐	☐	☐	☐	☐

C. For the following tests, indicate (✓) those procedures that you routinely use in antibody detection and/or antibody identification in your immunohematology laboratory.

ITEM	SHOULD BE REQUIRED FOR EXAM		REQUIRED IN THE WORK PLACE			
	YES	NO	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Saline room temperature	☐	☐	☐	☐	☐	☐
2. LISS room temperature	☐	☐	☐	☐	☐	☐
3. Saline 37°C	☐	☐	☐	☐	☐	☐
4. Albumin 37°C	☐	☐	☐	☐	☐	☐
5. LISS 37°C	☐	☐	☐	☐	☐	☐
6. Saline indirect antiglobulin	☐	☐	☐	☐	☐	☐
7. Albumin indirect antiglobulin	☐	☐	☐	☐	☐	☐
8. LISS 37°C indirect antiglobulin	☐	☐	☐	☐	☐	☐
9. one stage enzyme 37°C test	☐	☐	☐	☐	☐	☐

D. For each item below, check (✓) the appropriate responses

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CELT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. BLOOD GROUP SYSTEMS:										
a) ABO: secretor testing	☐	☐	○	○	☐	☐	☐	○	○	○
b) LEWIS: - method of detecting antigens in secretion	☐	☐	○	○	☐	☐	☐	○	○	○
c) RHESUS: - history of Rh system	☐	☐	○	○	☐	☐	☐	○	○	○
- Fisher-Race nomenclature	☐	☐	○	○	☐	☐	☐	○	○	○
- Wiener nomenclature	☐	☐	○	○	☐	☐	☐	○	○	○
- genetic basis of Du	☐	☐	○	○	☐	☐	☐	○	○	○
- characteristics of anti-G	☐	☐	○	○	☐	☐	☐	○	○	○
d) I: characteristics of anti-HI	☐	☐	○	○	☐	☐	☐	○	○	○
e) P: characteristics of anti-P (Donath-Landsteiner antibody)	☐	☐	○	○	☐	☐	☐	○	○	○
2. DIRECT & INDIRECT ANTIGLOBULIN TESTS:										
a) principles and uses	☐	☐	○	○	☐	☐	☐	○	○	○
b) quality control	☐	☐	○	○	☐	☐	☐	○	○	○
c) performance of test	☐	☐	○	○	☐	☐	☐	○	○	○
d) interpretation of results	☐	☐	○	○	☐	☐	☐	○	○	○
e) sources of error	☐	☐	○	○	☐	☐	☐	○	○	○
f) specificity of antiglobulin sera	☐	☐	○	○	☐	☐	☐	○	○	○
g) use of monospecific sera	☐	☐	○	○	☐	☐	☐	○	○	○

E. Does your laboratory routinely do antibody identifications ? YES ☐ NO ☐

If YES, indicate (✓) which of the following is required to work in your laboratory.

If NO, proceed to question F.

ITEM	SHOULD BE REQUIRED FOR EXAM		REQUIRED IN THE WORK PLACE			
	YES	NO	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. phenotyping	☐	☐	☐	☐	☐	☐
2. absorptions	☐	☐	☐	☐	☐	☐
3. heat elutions	☐	☐	☐	☐	☐	☐
4. use of 2 mercapto-ethanol	☐	☐	☐	☐	☐	☐
5. use of dithiothreitol	☐	☐	☐	☐	☐	☐
6. titrations	☐	☐	☐	☐	☐	☐
7. tests at 4°C, 18°C, 30°C	☐	☐	☐	☐	☐	☐

F. How well did your training prepare you to recognize the causes, the effects and the resolution of the following problems routinely encountered in the Immunohematology department?

ITEM	TOO MUCH PREPARATION	PREPARATION: OKAY	NOT ENOUGH PREPARATION	NOT PREPARED AT ALL
1. rouleaux formation	☐	☐	☐	☐
2. panagglutinins	☐	☐	☐	☐
3. polyagglutinins	☐	☐	☐	☐
4. cold autoagglutinins	☐	☐	☐	☐
5. Wharton's jelly	☐	☐	☐	☐
6. prozones	☐	☐	☐	☐
7. dosage effect	☐	☐	☐	☐
8. antigen/antibody deterioration	☐	☐	☐	☐
9. mixed field agglutination	☐	☐	☐	☐

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G. For each item below, indicate (✓) the appropriate responses

ITEM	REQUIRED IN THE WORK PLACE				CSLT SYLLABUS IS		
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Antibody detection and/or identification:							
a) criteria for the selection of screening cells	☐	☐	☐	☐	○	○	○
b) criteria for the selection of panel cells	☐	☐	☐	☐	○	○	○
c) use of cold autoabsorption	☐	☐	☐	☐	○	○	○
d) use of monospecific anti-IgG	☐	☐	☐	☐	○	○	○
e) detection of alloantibodies	☐	☐	☐	☐	○	○	○
f) specificity of autoantibodies (warm & cold)	☐	☐	☐	☐	○	○	○
g) drug induced hemolytic anemia: problems	☐	☐	☐	☐	○	○	○
2. Compatibility testing:							
a) verifying I.D. of the patient	☐	☐	☐	☐	○	○	○
b) verifying patient specimens	☐	☐	☐	☐	○	○	○
c) verifying donor units	☐	☐	☐	☐	○	○	○
d) significance of the following tests:							
i) saline room temperature	☐	☐	☐	☐	○	○	○
ii) LISS room temperature	☐	☐	☐	☐	○	○	○
iii) saline 37°C	☐	☐	☐	☐	○	○	○
iv) albumin 37°C	☐	☐	☐	☐	○	○	○
v) LISS 37°C	☐	☐	☐	☐	○	○	○
vi) saline indirect antiglobulin	☐	☐	☐	☐	○	○	○
vii) albumin indirect antiglobulin	☐	☐	☐	☐	○	○	○
viii) LISS 37°C indirect antiglobulin	☐	☐	☐	☐	○	○	○
ix) one stage enzyme 37°C test	☐	☐	☐	☐	○	○	○
x) two stage enzyme 37°C test	☐	☐	☐	☐	○	○	○
xi) enzyme antiglobulin	☐	☐	☐	☐	○	○	○
e) limitations of compatibility tests	☐	☐	☐	☐	○	○	○

B. For each item below, indicate (✓) the appropriate responses

ITEM	REQUIRED IN THE WORK PLACE				CSLT SYLLABUS IS		
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Selecting donor blood:							
a) in routine & emergency situations	☐	☐	☐	☐	○	○	○
b) when recipient's specimen is not available	☐	☐	☐	☐	○	○	○
c) when group specific blood is not available	☐	☐	☐	☐	○	○	○
d) N.B. of visual checking of donor units prior to issuing	☐	☐	☐	☐	○	○	○
2. High incidence antibodies: problems	☐	☐	☐	☐	○	○	○
3. Low incidence antibodies: problems	☐	☐	☐	☐	○	○	○
4. Transfusion reactions:							
a) allo-immunisation: consequences	☐	☐	☐	☐	○	○	○
b) criteria used to differentiate urticarial, anaphylactic, febrile & hemolytic reactions	☐	☐	☐	☐	○	○	○
c) preventive measures taken	☐	☐	☐	☐	○	○	○
d) procedure for investigation	☐	☐	☐	☐	○	○	○
5. Hemolytic disease of the newborn:							
a) causes and clinical symptoms	☐	☐	☐	☐	○	○	○
b) investigative tests: i) prenatal	☐	☐	☐	☐	○	○	○
ii) postnatal	☐	☐	☐	☐	○	○	○
c) acid elution test for detection of fetal red cells in maternal circulation	☐	☐	☐	☐	○	○	○
d) bile pigments in amniotic fluid: significance	☐	☐	☐	☐	○	○	○
e) constituents and use of Rh immune globulin	☐	☐	☐	☐	○	○	○
f) selection of donor blood: i) for exchange transfusion	☐	☐	☐	☐	○	○	○
ii) for intrauterine transfusion	☐	☐	☐	☐	○	○	○

SECTION 4 HEMATOLOGY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN HEMATOLOGY AT LEAST 30% OF THE TIME.
IF YOU DO NOT WORK IN HEMATOLOGY AT LEAST 30% OF THE TIME, MOVE ON TO SECTION 5 ⟶

A. For each method below, indicate (✓) what you feel you need to know as a new graduate to work effectively in Hematology.

METHODS	SELECTION OF ANTICOAGULANTS	COLLECTION & HANDLING OF SPECIMENS	PREPARATION OF REAGENTS	APPLICATION OF TEST	PERFORMANCE OF TEST	USE OF CONTROLS	SOURCES OF ERROR	NORMAL RANGE	SIGNIFICANCE OF ABNORMAL VALUES
1. Hemoglobin determination (manual)	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. RBC count (automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Hematocrit (manual and automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Indices	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Reticulocyte count	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. ESR: Wintrobe method	☐	☐	☐	☐	☐	☐	☐	☐	☐
Westergren method	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Osmotic fragility test	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. WBC count (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Microscopic sickling test	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Solubility test (Hgb S)	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. WBC differential count	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Corrected WBC count	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Platelet count (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Buffy coat preparation	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. CSF leukocyte count	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. CSF differential WBC count	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Preparation of slides for staining	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Template bleeding time	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Clot retraction	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. One-stage prothrombin time (manual and automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. APTT (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Thrombin time	☐	☐	☐	☐	☐	☐	☐	☐	☐

B. For the following peripheral blood cells and their precursors in the bone marrow, indicate (✓) what the NEW graduate needs to know for the work place.

	SHOULD BE REQUIRED FOR EXAM		REQUIRED IN THE WORK PLACE			
	YES	NO	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Peripheral blood: a) erythrocytes	☐	☐	☐	☐	☐	☐
b) leukocytes: mature granulocytes	☐	☐	☐	☐	☐	☐
lymphocytes	☐	☐	☐	☐	☐	☐
monocytes	☐	☐	☐	☐	☐	☐
c) platelets	☐	☐	☐	☐	☐	☐
2. Bone marrow precursors: a) blast cells	☐	☐	☐	☐	☐	☐
b) RBC: pronormoblast	☐	☐	☐	☐	☐	☐
basophilic normoblast	☐	☐	☐	☐	☐	☐
polychromatic normoblast	☐	☐	☐	☐	☐	☐
orthochromatic normoblast	☐	☐	☐	☐	☐	☐
c) WBC: promyelocyte	☐	☐	☐	☐	☐	☐
myelocyte	☐	☐	☐	☐	☐	☐
metamyelocyte	☐	☐	☐	☐	☐	☐
band cell	☐	☐	☐	☐	☐	☐
immature monocyte, and lymphocyte	☐	☐	☐	☐	☐	☐
d) megakaryocyte	☐	☐	☐	☐	☐	☐

C. For each staining method below, indicate (✓) the appropriate response.

STAINS	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			
	YES	NO	YES	NO	APPLICATION	PROCEDURE	PREPARATION OF REAGENTS	PRINCIPLE OF STAIN
1. Romanowsky stains: Wright's	☐	☐	○	○	☐	☐	☐	☐
Giemsa	☐	☐	○	○	☐	☐	☐	☐
2. Perls' Prussian blue reaction	☐	☐	○	○	☐	☐	☐	☐
3. Supravital stain (reticulocytes)	☐	☐	○	○	☐	☐	☐	☐

D. For each instrument below, indicate (✓) what a new graduate should know for the work place.

INSTRUMENTS	PRINCIPLE OF OPERATION	APPLICATION & USE	CALIBRATION	ROUTINE MAINTENANCE
1. Electronic cell counters	☐	☐	☐	☐
2. Hemoglobinometers	☐	☐	☐	☐
3. Automatic slide stainers	☐	☐	☐	☐
4. Coagulation timers	☐	☐	☐	☐
5. Microhematocrit centifuges	☐	☐	☐	☐

E. For each item below, indicate (✓) the appropriate response.

ITEM	REQUIRED IN THE WORK PLACE				CSLT SYLLABUS IS		
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
HEMOPOIESIS							
1. Role of bone marrow	☐	☐	☐	☐	○	○	○
2. Role of liver	☐	☐	☐	☐	○	○	○
3. Role of spleen	☐	☐	☐	☐	○	○	○
4. Role of lymph nodes	☐	☐	☐	☐	○	○	○
5. Sequential development of erythrocytes	☐	☐	☐	☐	○	○	○
6. Sequential development of leukocytes	☐	☐	☐	☐	○	○	○
7. Sequential development of megakaryocytes	☐	☐	☐	☐	○	○	○
8. Dietary requirements	☐	☐	☐	☐	○	○	○
9. Regulatory hormones	☐	☐	☐	☐	○	○	○
10. Life span of erythrocytes	☐	☐	☐	☐	○	○	○
11. Life span of leukocytes	☐	☐	☐	☐	○	○	○
12. Life span of platelets	☐	☐	☐	☐	○	○	○
13. Hemoglobin degradation	☐	☐	☐	☐	○	○	○
14. Hemoglobin excretion	☐	☐	☐	☐	○	○	○
15. Platelet role in hemostasis	☐	☐	☐	☐	○	○	○

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F. For each blood dyscrasia below, indicate (✓) the knowledge required in the work place by a new graduate.

BLOOD DYSCRASIAS	REQUIREMENT IN THE WORK PLACE				
	NOT REQUIRED	SIGNIFICANCE	PERIPHERAL BLOOD PICTURE	BONE MARROW PICTURE	ADDITIONAL TESTS
1. Post hemorrhagic anemia	☐	☐	☐	☐	☐
2. Iron deficiency anemia	☐	☐	☐	☐	☐
3. Megaloblastic anemia	☐	☐	☐	☐	☐
4. Hereditary spherocytosis	☐	☐	☐	☐	☐
5. Sickle cell anemia	☐	☐	☐	☐	☐
6. Thalassemia (major & minor)	☐	☐	☐	☐	☐
7. Aplastic anemia	☐	☐	☐	☐	☐
8. Acute/chronic granulocytic leukemia	☐	☐	☐	☐	☐
9. Acute/chronic lymphatic leukemia	☐	☐	☐	☐	☐
10. Acute monocytic leukemia	☐	☐	☐	☐	☐
11. Polycythemia (primary & secondary)	☐	☐	☐	☐	☐
12. Multiple myeloma	☐	☐	☐	☐	☐
13. Infectious mononucleosis	☐	☐	☐	☐	☐
14. Lupus erythematosus	☐	☐	☐	☐	☐

G. Does your laboratory routinely do coagulation studies ? YES ☐ NO ☐

If YES, indicate (✓) which of the following are required to work in your laboratory.

If NO, proceed to Question H ⟶

TESTS	NOT REQUIRED	SPECIMEN FOR TEST	PERFORMANCE OF TEST	USE OF CONTROLS	SOURCES OF ERROR	SIGNIFICANCE OF RESULTS
1. Prothrombin correction test	☐	☐	☐	☐	☐	☐
2. APTT correction test	☐	☐	☐	☐	☐	☐
3. Factor XIII screening test	☐	☐	☐	☐	☐	☐
4. Fibrinolysin detection: a) euglobulin lysis	☐	☐	☐	☐	☐	☐
b) fibrin and FDP	☐	☐	☐	☐	☐	☐

H. With regard to abnormal blood cell morphology, indicate (✓) all that is required for the work place and how the Syllabus of Studies applies to these requirements.

ABNORMAL BLOOD CELL MORPHOLOGY	REQUIREMENT IN THE WORK PLACE			CSLT SYLLABUS IS		
	NOT REQUIRED	APPEARANCE	SIGNIFICANCE	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Hypochromia	☐	☐	☐	○	○	○
2. Polychromasia	☐	☐	☐	○	○	○
3. Anisocytosis	☐	☐	☐	○	○	○
4. Poikilocytosis	☐	☐	☐	○	○	○
5. Microcytosis	☐	☐	☐	○	○	○
6. Macrocytosis	☐	☐	☐	○	○	○
7. Spherocytosis	☐	☐	☐	○	○	○
8. Ovalocytosis	☐	☐	☐	○	○	○
9. Burr cells	☐	☐	☐	○	○	○
10. Schistocytes	☐	☐	☐	○	○	○
11. Target cells	☐	☐	☐	○	○	○
12. Sickle cells	☐	☐	☐	○	○	○
13. Crenated cells	☐	☐	☐	○	○	○
14. Malarial parasites	☐	☐	☐	○	○	○
15. Stomatocytes	☐	☐	☐	○	○	○
16. Acanthocytes	☐	☐	☐	○	○	○
17. Red cell inclusions	☐	☐	☐	○	○	○
18. White cell inclusions	☐	☐	☐	○	○	○
19. Auer rods	☐	☐	☐	○	○	○
20. Hypersegmentation	☐	☐	☐	○	○	○
21. Pelger-Huet anomaly	☐	☐	☐	○	○	○
22. Leukopenia/Leukocytosis	☐	☐	☐	○	○	○
23. Thrombocytopenia/Thrombocytosis	☐	☐	☐	○	○	○
24. Atypical Lymphocytes	☐	☐	☐	○	○	○

SECTION 5: CLINICAL MICROBIOLOGY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN CLINICAL MICROBIOLOGY AT LEAST 30% OF THE TIME. IF YOU DO NOT WORK IN CLINICAL MICROBIOLOGY AT LEAST 30% OF THE TIME, PROCEED TO SECTION 6 ⟶

A. For each item below, check (✓) the appropriate responses.

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CELT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Characteristics of bacteria:										
a) nuclear structure	☐	☐	○	○	☐	☐	☐	○	○	○
b) cytoplasmic structure	☐	☐	○	○	☐	☐	☐	○	○	○
c) cell wall composition	☐	☐	○	○	☐	☐	☐	○	○	○
d) flagella	☐	☐	○	○	☐	☐	☐	○	○	○
e) method: nuclear division	☐	☐	○	○	☐	☐	☐	○	○	○
f) relationship with plant/animal kingdom	☐	☐	○	○	☐	☐	☐	○	○	○
g) bacterial growth curve	☐	☐	○	○	☐	☐	☐	○	○	○
h) morphology of bacterial colonies	☐	☐	○	○	☐	☐	☐	○	○	○
2. Anatomy of eubacterial cell	☐	☐	○	○	☐	☐	☐	○	○	○
3. Culture media: prep. & storage										
a) blood agar plates	☐	☐	○	○	☐	☐	☐	○	○	○
b) tube slanted media	☐	☐	○	○	☐	☐	☐	○	○	○
c) medium with heat sensitive ingredient	☐	☐	○	○	☐	☐	☐	○	○	○
d) checking/adjusting of pH	☐	☐	○	○	☐	☐	☐	○	○	○
e) criteria for pH 7 Eh indicators	☐	☐	○	○	☐	☐	☐	○	○	○
f) storage of dehydrated/prepared media	☐	☐	○	○	☐	☐	☐	○	○	○
4. Function & ingredients of:										
a) blood agar	☐	☐	○	○	☐	☐	☐	○	○	○
b) fluid media for primary culture	☐	☐	○	○	☐	☐	☐	○	○	○
c) differential media	☐	☐	○	○	☐	☐	☐	○	○	○
d) selective media	☐	☐	○	○	☐	☐	☐	○	○	○
e) transport media	☐	☐	○	○	☐	☐	☐	○	○	○

B. For the following differential procedures, indicate (✓) what is needed to work effectively in clinical microbiology.

DIFFERENTIAL PROCEDURES	PRINCIPLE	APPLICATION	INTERPRETATION	PERFORMANCE OF TEST	USE OF CONTROLS
1. Catalase test	☐	☐	☐	☐	☐
2. Slide/tube coagulase test	☐	☐	☐	☐	☐
3. Hemolysis on blood agar plates	☐	☐	☐	☐	☐
4. Bacitracin susceptibility	☐	☐	☐	☐	☐
5. Optochin sensitivity	☐	☐	☐	☐	☐
6. Bile solubility	☐	☐	☐	☐	☐
7. Esculin hydolysis	☐	☐	☐	☐	☐
8. Growth on 40% bile agar	☐	☐	☐	☐	☐
9. Growth in 6.5% NaCl broth	☐	☐	☐	☐	☐
10. Oxidase test	☐	☐	☐	☐	☐
11. Carbohydrate fermentation	☐	☐	☐	☐	☐
12. Triple sugar iron (TSI) agar	☐	☐	☐	☐	☐
13. Methylene red (MR) test	☐	☐	☐	☐	☐
14. Voges-Proskauer test	☐	☐	☐	☐	☐
15. ONPG test	☐	☐	☐	☐	☐
16. Indole production	☐	☐	☐	☐	☐
17. Urease test	☐	☐	☐	☐	☐
18. Simmons' citrate test	☐	☐	☐	☐	☐
19. Decarboxylase tests	☐	☐	☐	☐	☐
20. Phenylalanine deaminase test	☐	☐	☐	☐	☐
21. Nitrate/nitrite reduction	☐	☐	☐	☐	☐
22. Gelatinase test	☐	☐	☐	☐	☐
23. Pigment production	☐	☐	☐	☐	☐
24. H_2S production in TSI agar	☐	☐	☐	☐	☐
25. Motility	☐	☐	☐	☐	☐
26. X & V factor growth requirements	☐	☐	☐	☐	☐

C. For the following organisms, check (✓) what the new graduate needs to know to work effectively in clinical microbiology.

ORGANISMS	CELLULAR MORPHOLOGY	STAINING REACTIONS	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCE OF INFECTION	PATHOGENICITY	COLONIAL MORPHOLOGY	ISOLATION PROCEDURES	IDENTIFICATION PROCEDURES
1. Staphylococcus aureus	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Staphylococcus epidermidis	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Micrococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Streptococcus pyogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Viridans group	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Enterococcus group	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Streptococcus pneumoniae	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Streptococci (groups B, C, & G)	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Peptococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Peptostreptococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Lactobacillus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Corynebacterium diphtheriae	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Diphtheroids	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Actinomyces israelii	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Nocardia asteroides	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Mycobacterium tuberculosis	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Listeria monocytogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Bacillus anthracis	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Bacillus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Clostridium perfringens	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Clostridium tetani	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Clostridium botulinum	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Neisseria gonorrhoeae	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Neisseria meningitidis	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Neisseria lactamica	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. Branhamella catarrhalis	☐	☐	☐	☐	☐	☐	☐	☐	☐
27. Acinetobacter species	☐	☐	☐	☐	☐	☐	☐	☐	☐

D. For the following organisms, check (✓) what the new graduate needs to know to work effectively in clinical microbiology.

ORGANISMS	CELLULAR MORPHOLOGY	STAINING REACTIONS	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCE OF INFECTION	PATHOGENICITY	COLONIAL MORPHOLOGY	ISOLATION PROCEDURES	IDENTIFICATION PROCEDURES
1. Escherichia coli	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Edwardsiella tarda	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Citrobacter species	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Salmonella typhi	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Salmonella arizonae	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Salmonella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Shigella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Klebsiella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Enterobacter cloacae	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Enterobacter aerogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Hafnia alvei	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Serratia marcescens	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Proteus mirabilis	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Yersinia enterocolitica	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Vibrio	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Aeromonas	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Haemophilus influenzae	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Gardnerella (haemophilis) vaginalis	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Pasteurella multocida	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Pseudomonas aeruginosa	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Alcaligenes species	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Brucella abortus	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Bordetella pertussis	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Bacteroides species	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Treponema pallidum	☐	☐	☐	☐	☐	☐	☐	☐	☐

E. For each clinical specimen below, check (✓) those items required for proper examination of specimen in the work place.

CLINICAL SPECIMENS	SAFETY PRECAUTIONS	SUITABILITY OF SPECIMEN	MACROSCOPIC EXAMINATION	MICROSCOPIC EXAMINATION	APPROPRIATE MEDIA	INOCULATION OF PRIMARY ISOLATION MEDIA	TESTS FOR IDENTIFICATION	NEED FOR PRELIMINARY REPORT
1. Blood culture	☐	☐	☐	☐	☐	☐	☐	☐
2. CSF	☐	☐	☐	☐	☐	☐	☐	☐
3. Effusions	☐	☐	☐	☐	☐	☐	☐	☐
4. Biopsied tissue	☐	☐	☐	☐	☐	☐	☐	☐
5. Surgical wounds	☐	☐	☐	☐	☐	☐	☐	☐
6. Urine	☐	☐	☐	☐	☐	☐	☐	☐
7. Feces	☐	☐	☐	☐	☐	☐	☐	☐
8. Sputum	☐	☐	☐	☐	☐	☐	☐	☐
9. Swab from ear	☐	☐	☐	☐	☐	☐	☐	☐
10. Swab from nose	☐	☐	☐	☐	☐	☐	☐	☐
11. Swab from throat	☐	☐	☐	☐	☐	☐	☐	☐
12. Swab from nasopharynx	☐	☐	☐	☐	☐	☐	☐	☐
13. Swab from skin	☐	☐	☐	☐	☐	☐	☐	☐
14. Swab from genital tract	☐	☐	☐	☐	☐	☐	☐	☐

F. Does your laboratory routinely do mycology? Yes ☐ No ☐

If YES, indicate (✓) which of the following is required to work effectively in your laboratory.

If NO, proceed to question G ⟶

YEAST-LIKE FUNGI	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCES OF INFECTION	PATHOGENICITY	DIFFERENTIATION OF ORGANISM
1. Candida albicans	☐	☐	☐	☐	☐
2. Other Candida species	☐	☐	☐	☐	☐
3. Cryptococcus neoformans	☐	☐	☐	☐	☐
4. Other cryptococcus species	☐	☐	☐	☐	☐
5. Torulopsis glabrata	☐	☐	☐	☐	☐

G. For each item below, check (✓) the appropriate responses.

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Quality control: sterility testing	☐	☐	○	○	☐	☐	☐	○	○	○
2. Culturing:										
a) Streaking petri plate media	☐	☐	○	○	☐	☐	☐	○	○	○
b) Transfering bacteria by wire loop/ needle	☐	☐	○	○	☐	☐	☐	○	○	○
c) Accurate pipetting of bacterial suspensions	☐	☐	○	○	☐	☐	☐	○	○	○
d) Inoculation of broth cultures	☐	☐	○	○	☐	☐	☐	○	○	○
e) Selective cultivation of micro-organisms	☐	☐	○	○	☐	☐	☐	○	○	○
f) Viable counts using loop technique	☐	☐	○	○	☐	☐	☐	○	○	○
g) Use of dipslides	☐	☐	○	○	☐	☐	☐	○	○	○
h) Anaerobic culturing using anaerobic jar	☐	☐	○	○	☐	☐	☐	○	○	○
i) Use of Eh indicators	☐	☐	○	○	☐	☐	☐	○	○	○
j) Culturing in CO_2 atmosphere	☐	☐	○	○	☐	☐	☐	○	○	○
k) Preservation of stock cultures	☐	☐	○	○	☐	☐	☐	○	○	○
3. Blood cultures: a) collection of specimens	☐	☐	○	○	☐	☐	☐	○	○	○
b) subculturing	☐	☐	○	○	☐	☐	☐	○	○	○
c) incubation periods										
4. Cerebrospinal fluid:										
a) significance of presence of WBC cells	☐	☐	○	○	☐	☐	☐	○	○	○
5. Respiratory Tract:										
a) technique for liquefaction of sputum	☐	☐	○	○	☐	☐	☐	○	○	○
b) microscopic appearance of Vincent's infection	☐	☐	○	○	☐	☐	☐	○	○	○
6. Microscopic examination										
a) wet preparations for motility	☐	☐	○	○	☐	☐	☐	○	○	○
b) use of Gram stain	☐	☐	○	○	☐	☐	☐	○	○	○

H. For each item below, check (/) the appropriate responses.

ITEM	1 SHOULD BE REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CELT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
Antimicrobial susceptibility testing										
1. Bacteriostatic activity	☐	☐	○	○	☐	☐	☐	○	○	○
2. Bactericidal activity	☐	☐	○	○	☐	☐	☐	○	○	○
3. Antimicrobial spectrum of antibodies	☐	☐	○	○	☐	☐	☐	○	○	○
4. Use of Kirby-Bauer technique:										
a) prep. of MacFarland $BaSO_4$ standard	☐	☐	○	○	☐	☐	☐	○	○	○
b) prep./standardization of inoculum	☐	☐	○	○	☐	☐	☐	○	○	○
c) use of Mueller-Hinton agar	☐	☐	○	○	☐	☐	☐	○	○	○
d) preparation/inoculation of agar plates	☐	☐	○	○	☐	☐	☐	○	○	○
e) reading/interpretation of results	☐	☐	○	○	☐	☐	☐	○	○	○
f) storage of discs	☐	☐	○	○	☐	☐	☐	○	○	○
g) limitations of the technique	☐	☐	○	○	☐	☐	☐	○	○	○
5. Detection of B-lactamase production	☐	☐	○	○	☐	☐	☐	○	○	○
6. Principle of the Schlichter test (serum bactericidal level)	☐	☐	○	○	☐	☐	☐	○	○	○
7. Parasitology										
a) use of Scotch Ⓡ tape preparations	☐	☐	○	○	☐	☐	☐	○	○	○
b) morphology of pinworm eggs	☐	☐	○	○	☐	☐	☐	○	○	○
c) wet mounts for Trichomonas vaginalis	☐	☐	○	○	☐	☐	☐	○	○	○
8. Active immunization:										
a) use of live attenuated vaccines	☐	☐	○	○	☐	☐	☐	○	○	○
b) use of killed vaccines	☐	☐	○	○	☐	☐	☐	○	○	○
c) use of toxoids	☐	☐	○	○	☐	☐	☐	○	○	○
9. Passive immunization										
a) use of antitoxins	☐	☐	○	○	☐	☐	☐	○	○	○

I. For each serological method below, check (✓) what information a new graduate needs to know to work in clinical microbiology.

SEROLOGICAL METHODS	PRINCIPLE	APPLICATION	INTERPRETATION	PERFORMANCE OF TEST	USE OF CONTROLS
1. Slide agglutination tests (for enteropathogenic E. Coli)	☐	☐	☐	☐	☐
2. Lancefield grouping	☐	☐	☐	☐	☐
3. Nagler reaction	☐	☐	☐	☐	☐
4. Elek test	☐	☐	☐	☐	☐

J. For the following tests, indicate (✓) the appropriate responses.

TESTS	REQUIREMENT IN THE WORK PLACE					
	NOT REQUIRED	NATURE OF ANTIGEN	INCUBATION TIME	INACTIVATION OF SERUM (IF NECESSARY)	READING/REPORTING OF RESULTS	USE OF CONTROLS
1. Screen test for heterophile antibody	☐	☐	☐	☐	☐	☐
2. Anti-streptolysin O titration (ASO)	☐	☐	☐	☐	☐	☐
3. Widal agglutination test	☐	☐	☐	☐	☐	☐
4. Brucella agglutination test	☐	☐	☐	☐	☐	☐

SECTION 6: CLINICAL CHEMISTRY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN CLINICAL CHEMISTRY AT LEAST 30% OF THE TIME.
IF YOU DO NOT WORK IN CLINICAL CHEMISTRY AT LEAST 30% OF THE TIME, PROCEED TO SECTION 7

A. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Carbohydrates:										
a) differentiate between mono-, di- and poly- saccharides	☐	☐	○	○	☐	☐	☐	○	○	○
b) reducing vs non-reducing sugar	☐	☐	○	○	☐	☐	☐	○	○	○
c) carbohydrate metabolism	☐	☐	○	○	☐	☐	☐	○	○	○
d) oral glucose tolerance test	☐	☐	○	○	☐	☐	☐	○	○	○
e) 2 hour p.c. blood sugar	☐	☐	○	○	☐	☐	☐	○	○	○
2. Lipids: a) solubility characteristics	☐	☐	○	○	☐	☐	☐	○	○	○
b) simple vs compound lipid	☐	☐	○	○	☐	☐	☐	○	○	○
c) structure of cholesterol	☐	☐	○	○	☐	☐	☐	○	○	○
d) structure of triglycerides	☐	☐	○	○	☐	☐	☐	○	○	○
e) fatty acid oxidation	☐	☐	○	○	☐	☐	☐	○	○	○
3. Proteins: describe ...										
a) primary structure	☐	☐	○	○	☐	☐	☐	○	○	○
b) secondary structure	☐	☐	○	○	☐	☐	☐	○	○	○
c) tertiary structure	☐	☐	○	○	☐	☐	☐	○	○	○
d) amphoteric properties of proteins	☐	☐	○	○	☐	☐	☐	○	○	○
e) five major protein groups (separated by electrophoresis)	☐	☐	○	○	☐	☐	☐	○	○	○
4. Non-protein Nitrogenous Substances:										
a) formation/excretion of: a) urea	☐	☐	○	○	☐	☐	☐	○	○	○
b) creatinine	☐	☐	○	○	☐	☐	☐	○	○	○
c) uric acid	☐	☐	○	○	☐	☐	☐	○	○	○

B. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CBLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Acid-base & Electrolytes:										
a) control of blood pH by buffer systems	☐	☐	○	○	☐	☐	☐	○	○	○
b) regulation of pH by renal system	☐	☐	○	○	☐	☐	☐	○	○	○
c) regulation of pH by respiratory system	☐	☐	○	○	☐	☐	☐	○	○	○
d) use of Henderson-Hasselbalch equation	☐	☐	○	○	☐	☐	☐	○	○	○
e) hemoglobin as an oxygen carrier	☐	☐	○	○	☐	☐	☐	○	○	○
f) anions and cations in blood	☐	☐	○	○	☐	☐	☐	○	○	○
g) metabolism of electrolytes	☐	☐	○	○	☐	☐	☐	○	○	○
h) osmolality	☐	☐	○	○	☐	☐	☐	○	○	○
2. Enzymes: a) general structure	☐	☐	○	○	☐	☐	☐	○	○	○
b) catalytic properties	☐	☐	○	○	☐	☐	☐	○	○	○
c) classification	☐	☐	○	○	☐	☐	☐	○	○	○
d) enzyme activity: what effects?	☐	☐	○	○	☐	☐	☐	○	○	○
e) measurements: endpoint vs kinetic types	☐	☐	○	○	☐	☐	☐	○	○	○
f) define isoenzyme	☐	☐	○	○	☐	☐	☐	○	○	○
3. Ligand Assay: a) principle	☐	☐	○	○	☐	☐	☐	○	○	○
b) basic concepts of: - CPB	☐	☐	○	○	☐	☐	☐	○	○	○
- FIA	☐	☐	○	○	☐	☐	☐	○	○	○
- EIA	☐	☐	○	○	☐	☐	☐	○	○	○
4. Liver Function: a) role of liver in:										
- carbohydrate metabolism	☐	☐	○	○	☐	☐	☐	○	○	○
- protein metabolism	☐	☐	○	○	☐	☐	☐	○	○	○
- lipid metabolism	☐	☐	○	○	☐	☐	☐	○	○	○
- detoxification	☐	☐	○	○	☐	☐	☐	○	○	○
- bilirubin metabolism	☐	☐	○	○	☐	☐	☐	○	○	○

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C. For each method below, indicate (√) what you feel you need to know as a new graduate to work effectively in Clinical Chemistry.

SELECTED METHODS	SELECTION OF ANTICOAGULANT	COLLECTION & HANDLING OF SPECIMENS	PREPARATION OF REAGENTS	PRINCIPLE & PROCEDURE	CALCULATING & REPORTING RESULTS	REFERENCE VALUES	SOURCES OF ERROR	SIGNIFICANCE OF ABNORMAL RESULTS
1. Glucose: a) hexokinase	☐	☐	☐	☐	☐	☐	☐	☐
b) glucose oxidase	☐	☐	☐	☐	☐	☐	☐	☐
2. Cholesterol: enzymatic method	☐	☐	☐	☐	☐	☐	☐	☐
3. Proteins: a) biuret reaction	☐	☐	☐	☐	☐	☐	☐	☐
b) dye binding (albumin)	☐	☐	☐	☐	☐	☐	☐	☐
c) electrophoresis	☐	☐	☐	☐	☐	☐	☐	☐
4. Urea: a) diacetyl monoxime method	☐	☐	☐	☐	☐	☐	☐	☐
b) urease method	☐	☐	☐	☐	☐	☐	☐	☐
c) conductance electrode	☐	☐	☐	☐	☐	☐	☐	☐
5. Creatinine: Jaffé reaction	☐	☐	☐	☐	☐	☐	☐	☐
6. Acid-base: pO, pCO_2, CO_2 and pH:								
a) direct electrode method	☐	☐	☐	☐	☐	☐	☐	☐
b) CO_2: automated method	☐	☐	☐	☐	☐	☐	☐	☐
7. Sodium & Potassium:								
a) flame photometry	☐	☐	☐	☐	☐	☐	☐	☐
b) ion-selective electrode	☐	☐	☐	☐	☐	☐	☐	☐
8. Chloride: chloridometer	☐	☐	☐	☐	☐	☐	☐	☐
9. Calcium: a) atomic absorption	☐	☐	☐	☐	☐	☐	☐	☐
b) o-cresophthalein complexone	☐	☐	☐	☐	☐	☐	☐	☐
10. Phosphorus: method involving reduction of molybdenum blue	☐	☐	☐	☐	☐	☐	☐	☐
11. Alkaline phosphatase:								
a) p-nitrophenylphosphate	☐	☐	☐	☐	☐	☐	☐	☐
12. Bilirubin: Jendrassik & Groff	☐	☐	☐	☐	☐	☐	☐	☐
13. Toxicology: Salicylate determination	☐	☐	☐	☐	☐	☐	☐	☐

D. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Renal function: a) role of the kidney in:										
- excretion of waste products	☐	☐	○	○	☐	☐	☐	○	○	○
- osmoregulation	☐	☐	○	○	☐	☐	☐	○	○	○
- acid-base/electrolyte regulation	☐	☐	○	○	☐	☐	☐	○	○	○
2. Evaluation of renal function by:										
- osmolality	☐	☐	○	○	☐	☐	☐	○	○	○
- specific gravity	☐	☐	○	○	☐	☐	☐	○	○	○
- creatinine clearance	☐	☐	○	○	☐	☐	☐	○	○	○
3. Pregnancy test: a) principle	☐	☐	○	○	☐	☐	☐	○	○	○
b) limitations	☐	☐	○	○	☐	☐	☐	○	○	○
c) sources of error	☐	☐	○	○	☐	☐	☐	○	○	○
4. Statistics: a) terminology	☐	☐	○	○	☐	☐	☐	○	○	○
b) Gaussian distribution	☐	☐	○	○	☐	☐	☐	○	○	○
c) non-Gaussian distribution	☐	☐	○	○	☐	☐	☐	○	○	○
5. Reference interval (normal values):										
a) calculation	☐	☐	○	○	☐	☐	☐	○	○	○
b) need to establish for lab	☐	☐	○	○	☐	☐	☐	○	○	○
c) effects of physiological variables	☐	☐	○	○	☐	☐	☐	○	○	○
6. Laboratory Application of quality control:										
a) primary vs secondary standards	☐	☐	○	○	☐	☐	☐	○	○	○
b) standards vs controls	☐	☐	○	○	☐	☐	☐	○	○	○
c) commercial controls vs in-house pools	☐	☐	○	○	☐	☐	☐	○	○	○
d) prep. & use: - stock standards	☐	☐	○	○	☐	☐	☐	○	○	○
- working standards	☐	☐	○	○	☐	☐	☐	○	○	○
e) for methods: - specificity	☐	☐	○	○	☐	☐	☐	○	○	○
- sensitivity	☐	☐	○	○	☐	☐	☐	○	○	○

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E. For each instrument below, indicate (✓) all that is required by a new graduate to work effectively in clinical chemistry.

INSTRUMENTS	REQUIREMENT IN THE WORK PLACE		
	NOT REQUIRED	PRINCIPLE	APPLICATION
1. Continuous flow analyzer	☐	☐	☐
2. Centrifugal analyzer	☐	☐	☐
3. Discrete analyzer	☐	☐	☐
4. Fluorometer	☐	☐	☐
5. Atomic absorption spectrophotometer	☐	☐	☐
6. Flame photometer	☐	☐	☐
7. Densitometer	☐	☐	☐
8. Osmometer	☐	☐	☐
9. Chloridometer	☐	☐	☐
10. Nephelometer	☐	☐	☐
11. Refractometer	☐	☐	☐

F. For each item below, indicate (✓) the depth of knowledge of spectrophotometry required in the work place.

ITEM	REQUIRED FOR EXAM		REQUIRED IN THE WORK PLACE			
	YES	NO	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Monochromators: principle, application and limitations	☐	☐	○	○	○	○
2. Light sources: uses	☐	☐	○	○	○	○
3. Cuvettes: types	☐	☐	○	○	○	○
4. Photodetectors: principle/uses of:						
a) barrier layer cell	☐	☐	○	○	○	○
b) photoemissive tube	☐	☐	○	○	○	○
c) photomultiplier tube	☐	☐	○	○	○	○
5. Function of: a) galvanometer	☐	☐	○	○	○	○
b) potentiometer	☐	☐	○	○	○	○
6. Checking wavelength calibration	☐	☐	○	○	○	○

G. For each specimen below, indicate (✓) the tests and methods that a new graduate needs to know in the work place.

SPECIMEN	REQUIREMENT IN THE WORK PLACE			CSLT SYLLABUS IS		
	NOT REQUIRED	PERFORMANCE OF THE TEST	SIGNIFICANCE	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Urine: a) routine analysis:						
- color	☐	☐	☐	○	○	○
- pH	☐	☐	☐	○	○	○
- specific gravity	☐	☐	☐	○	○	○
- protein	☐	☐	☐	○	○	○
- glucose	☐	☐	☐	○	○	○
- bile pigments	☐	☐	☐	○	○	○
- blood	☐	☐	☐	○	○	○
- ketones	☐	☐	☐	○	○	○
- microscopic examination	☐	☐	☐	○	○	○
2. Urine: b) special tests:						
- urobilinogen	☐	☐	☐	○	○	○
- porphobilinogen	☐	☐	☐	○	○	○
- Bence-Jones protein	☐	☐	☐	○	○	○
- for cystine	☐	☐	☐	○	○	○
- phenylpyruvic acid	☐	☐	☐	○	○	○
3. Feces: a) macroscopic appearance	☐	☐	☐	○	○	○
b) tests for: - occult blood	☐	☐	☐	○	○	○
- fecal fat	☐	☐	☐	○	○	○
- bile/urobilinogen	☐	☐	☐	○	○	○
4. CSF: a) estimation of a) protein	☐	☐	☐	○	○	○
b) glucose	☐	☐	☐	○	○	○
b) clin. significance of results	☐	☐	☐	○	○	○
5. Gastric Analysis:						
a) principle of tube method	☐	☐	☐	○	○	○
b) method to determine acidity	☐	☐	☐	○	○	○

SECTION 7: HISTOTECHNOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN HISTOTECHNOLOGY AT LEAST 30% OF THE TIME. IF YOU DO NOT WORK IN HISTOTECHNOLOGY AT LEAST 30% OF THE TIME, OMIT THIS SECTION.

A. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Normal histology of primary tissues:										
a) epithelium	☐	☐	○	○	☐	☐	☐	○	○	○
b) connective tissue	☐	☐	○	○	☐	☐	☐	○	○	○
c) muscle tissue	☐	☐	○	○	☐	☐	☐	○	○	○
d) nervous tissue	☐	☐	○	○	☐	☐	☐	○	○	○
2. Fixation:										
a) purpose	☐	☐	○	○	☐	☐	☐	○	○	○
b) effect on tissue components	☐	☐	○	○	☐	☐	☐	○	○	○
c) effects of autolysis & putrefaction	☐	☐	○	○	☐	☐	☐	○	○	○
d) effect of heat, vacuum & agitation	☐	☐	○	○	☐	☐	☐	○	○	○
3. Infiltration with paraffin:										
a) characteristics of commercial paraffin	☐	☐	○	○	☐	☐	☐	○	○	○
b) use of vacuum infiltration	☐	☐	○	○	☐	☐	☐	○	○	○
4. Processing equipment: operation, advantages & disadvantages of:										
a) Autotechnicon® type	☐	☐	○	○	☐	☐	☐	○	○	○
b) fluid exchange	☐	☐	○	○	☐	☐	☐	○	○	○
5. Embedding:										
a) use of embedding equipment	☐	☐	○	○	☐	☐	☐	○	○	○
b) practical orientation of tissue	☐	☐	○	○	☐	☐	☐	○	○	○
c) sources of error	☐	☐	○	○	☐	☐	☐	○	○	○
d) corrective procedures	☐	☐	○	○	☐	☐	☐	○	○	○

B. For each fixative agent and compound fixative, indicate (√) what a new graduate needs to know to function effectively in Histotechnology.

ITEM	THEORY	USES	ADVANTAGES	DISADVANTAGES
1. Formaldehyde	☐	☐	☐	☐
2. Mercuric chloride	☐	☐	☐	☐
3. Potassium dichromate	☐	☐	☐	☐
4. Picric Acid	☐	☐	☐	☐
5. Osmium tetroxide	☐	☐	☐	☐
6. Ethanol	☐	☐	☐	☐
7. N.B.F.S.	☐	☐	☐	☐
8. Zenker's	☐	☐	☐	☐
9. Helly's	☐	☐	☐	☐
10. Bouin's	☐	☐	☐	☐

C. In decalcification, indicate (√) what a new graduate needs to know to function effectively in Histotechnology.

ITEM	PRINCIPLE	USE	ADVANTAGES	DISADVANTAGES
1. Formic Acid	☐	☐	☐	☐
2. Nitric Acid	☐	☐	☐	☐
3. EDTA	☐	☐	☐	☐
4. Tests for endpoint:				
a) chemical	☐	☐	☐	☐
b) radiological	☐	☐	☐	☐
c) physical probing	☐	☐	☐	☐

D. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Microtome knives:										
a) how many degrees is: i) wedge angle	☐	☐	○	○	☐	☐	☐	○	○	○
ii) clearance angle	☐	☐	○	○	☐	☐	☐	○	○	○
b) definition of cutting facet	☐	☐	○	○	☐	☐	☐	○	○	○
2. Automatic knife sharpeners:										
a) routine maintenance	☐	☐	○	○	☐	☐	☐	○	○	○
b) relevance of abrasive particle size to:										
i) honing (coarse)	☐	☐	○	○	☐	☐	☐	○	○	○
ii) stropping (fine)	☐	☐	○	○	☐	☐	☐	○	○	○
3. Rotary microtome: a) operation	☐	☐	○	○	☐	☐	☐	○	○	○
b) importance of clearance angle	☐	☐	○	○	☐	☐	☐	○	○	○
c) routine maintenance	☐	☐	○	○	☐	☐	☐	○	○	○
4. Dye chemistry: understanding . . .										
a) resonance systems	☐	☐	○	○	☐	☐	☐	○	○	○
b) dye structure terminology:										
i) chromophore	☐	☐	○	○	☐	☐	☐	○	○	○
ii) chromogen	☐	☐	○	○	☐	☐	☐	○	○	○
iii) auxochrome	☐	☐	○	○	☐	☐	☐	○	○	○
c) acid, base & neutral dyes and their staining properties	☐	☐	○	○	☐	☐	☐	○	○	○
d) physical theory of staining	☐	☐	○	○	☐	☐	☐	○	○	○
e) chemical theory of staining:										
i) salt linkage	☐	☐	○	○	☐	☐	☐	○	○	○
ii) hydrogen bond	☐	☐	○	○	☐	☐	☐	○	○	○
iii) metachromasia	☐	☐	○	○	☐	☐	☐	○	○	○
iv) metallic impregnation	☐	☐	○	○	☐	☐	☐	○	○	○
v) leuco staining	☐	☐	○	○	☐	☐	☐	○	○	○

E. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CELT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Paraffin sectioning:										
a) effect of block temp. on sections	☐	☐	○	○	☐	☐	☐	○	○	○
b) effect of cutting speed on sections	☐	☐	○	○	☐	☐	☐	○	○	○
c) common cutting faults: recognition, causes and remedies	☐	☐	○	○	☐	☐	☐	○	○	○
d) floating out sections: purpose	☐	☐	○	○	☐	☐	☐	○	○	○
e) advantages/disadvantages of adding section adhesives to: i) water bath	☐	☐	○	○	☐	☐	☐	○	○	○
ii) slides	☐	☐	○	○	☐	☐	☐	○	○	○
f) serial sectioning: use & practice	☐	☐	○	○	☐	☐	☐	○	○	○
g) step sectioning: use & practice	☐	☐	○	○	☐	☐	☐	○	○	○
2. Staining practices:										
a) proper storage of dyes	☐	☐	○	○	☐	☐	☐	○	○	○
b) relevance of color index numbers	☐	☐	○	○	☐	☐	☐	○	○	○
c) principle & application of:										
i) progressive/regressing staining	☐	☐	○	○	☐	☐	☐	○	○	○
ii) acid differentiation	☐	☐	○	○	☐	☐	☐	○	○	○
iii) mordant differentiation	☐	☐	○	○	☐	☐	☐	○	○	○
iv) decolorization	☐	☐	○	○	☐	☐	☐	○	○	○
v) direct staining	☐	☐	○	○	☐	☐	☐	○	○	○
vi) indirect staining	☐	☐	○	○	☐	☐	☐	○	○	○
vii) use of accentuators	☐	☐	○	○	☐	☐	☐	○	○	○
viii) argyrophil reaction	☐	☐	○	○	☐	☐	☐	○	○	○
ix) argentaffin reaction	☐	☐	○	○	☐	☐	☐	○	○	○

F. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR EXAM		2 REQUIRED FOR WORK PLACE		3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:			4 CSLT SYLLABUS IS:		
	YES	NO	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL	TOO DETAILED	OKAY	NOT ENOUGH DETAIL
1. Cryostat:										
a) use of anti-roll device	☐	☐	○	○	☐	☐	☐	○	○	○
b) disinfection	☐	☐	○	○	☐	☐	☐	○	○	○
c) routine maintenance	☐	☐	○	○	☐	☐	☐	○	○	○
d) procedure and practice for:										
i) cutting unfixed tissue	☐	☐	○	○	☐	☐	☐	○	○	○
ii) cutting fixed tissue	☐	☐	○	○	☐	☐	☐	○	○	○
e) cause & appearance of ice crystal artifact	☐	☐	○	○	☐	☐	☐	○	○	○
f) rapid H & E stain: procedure	☐	☐	○	○	☐	☐	☐	○	○	○
g) polychrome methylene blue stain: procedure	☐	☐	○	○	☐	☐	☐	○	○	○
h) use of cryostat sections for:										
i) lipid stains	☐	☐	○	○	☐	☐	☐	○	○	○
ii) demonstrating enzymes	☐	☐	○	○	☐	☐	☐	○	○	○
3. Dewaxing paraffin sections	☐	☐	○	○	☐	☐	☐	○	○	○
4. Hydrating paraffin sections	☐	☐	○	○	☐	☐	☐	○	○	○
5. Removal of fixation artifacts	☐	☐	○	○	☐	☐	☐	○	○	○
6. Celloidin coating sections	☐	☐	○	○	☐	☐	☐	○	○	○
7. Coverslipping using:										
a) resinous mountants	☐	☐	○	○	☐	☐	☐	○	○	○
b) aqueous mountants	☐	☐	○	○	☐	☐	☐	○	○	○
8. Refractive index of mounting media	☐	☐	○	○	☐	☐	☐	○	○	○

G. For each specific staining method below, indicate (✓) what a new graduate needs to know to work effectively in Histotechnology.

ITEM	THEORY	PREPARATION OF REAGENTS	PRACTISE	EVALUATION OF RESULTS	CORRECTIVE ACTION	CHOOSING CONTROL TISSUE	SAFETY PRECAUTIONS
1. Hematoxylin & Eosin	☐	☐	☐	☐	☐	☐	☐
2. Masson trichome	☐	☐	☐	☐	☐	☐	☐
3. Weigert van Gieson	☐	☐	☐	☐	☐	☐	☐
4. Silver impregnation for reticulin	☐	☐	☐	☐	☐	☐	☐
5. P.A.S. (Periodic Acid Schiff)	☐	☐	☐	☐	☐	☐	☐
6. P.A.S. with diastase control	☐	☐	☐	☐	☐	☐	☐
7. Perls' Prussian Blue	☐	☐	☐	☐	☐	☐	☐
8. Argentaffin method for melanin	☐	☐	☐	☐	☐	☐	☐
9. Modified Gram stain	☐	☐	☐	☐	☐	☐	☐
10. Ziehl-Neelsen	☐	☐	☐	☐	☐	☐	☐
11. Gomori's methenamine silver	☐	☐	☐	☐	☐	☐	☐
12. Oil Red O	☐	☐	☐	☐	☐	☐	☐
13. Luxol fast blue/cresyl echt violet	☐	☐	☐	☐	☐	☐	☐

H. In paraffin processing, indicate (✓) what the new graduate needs to know regarding each dehydration agent and clearing agent.

ITEM		USES	ADVANTAGES	DISADVANTAGES	CORRECTIVE PROCEDURE
1. DEHYDRATION AGENTS:	a) ethanol	☐	☐	☐	☐
	b) isopropanol	☐	☐	☐	☐
	c) acetone	☐	☐	☐	☐
2. CLEARING AGENTS:	a) xylene	☐	☐	☐	☐
	b) toluene	☐	☐	☐	☐
	c) chloroform	☐	☐	☐	☐

APPENDIX F

EMPLOYER SURVEY

Canadian Society of Laboratory Technologists
Association canadienne des technologistes de laboratoire

Dear prospective employer,

The C.S.L.T. is conducting a validation survey to determine to what extent the R.T. (General) Syllabus reflects the actual needs of the employer and the new graduate in the work place. As a prospective employer of newly certified technologists, we are requesting your assistance in this project.

Please complete the questionnaire as outlined in the following instruction page and return it in the enclosed stamped envelope before . Since we are polling a limited number of prospective employers, it is essential that each surveyed individual complete and return the questionnaire. Your personal participation is very important to the success of this project.

This is your opportunity to influence the certification process and to assist in the next revision of the Syllabus. In this way, the C.S.L.T. will feel confident that it is preparing its new graduates to meet the challenges of the clinical laboratory.

Thank you for your time and honest response.

Norman Senn
President
C.S.L.T.

Sister Dorothy Ryan
Validation Co-ordinator

Dr. K. Puffer, Ph. D.
Chairman
Thesis Committee

P.O. C.P. 830 Hamilton, Ontario L8N 3N8 (416) 528-8642

INSTRUCTIONS

The main purpose of this employer survey is to validate the C.S.L.T. Syllabus of Studies in the work place to see if it meets the needs of the new graduate.

You do not need the Syllabus to complete the questionnaire since the level of detail, the categories and the wording of the questions are taken directly from the student requirements of the Syllabus.

You may not be required to complete the entire survey. The following detailed instructions are to assist you in answering the questionnaire.

SECTION 1:GENERAL INFORMATION	to be completed by ALL employers.
SECTION 2: GENERAL KNOWLEDGE	to be completed by ALL employers.
SECTIONS 3-7: INDIVIDUAL DISCIPLINES	complete only those sections that are applicable to your laboratory. If you do not have a particular department within your laboratory, omit that part of the questionnaire.

EXAMPLE: If you send your histotechnology specimens to a referral laboratory, you should omit that part of the questionnaire because you will not be able to respond adequately to the needs of the work place.

THANK YOU

PROCEED TO SECTION 1 ➔

SECTION 1: GENERAL INFORMATION

A. EMPLOYMENT DATA

1. Type of laboratory:
   - a) ☐ hospital
   - b) ☐ private laboratory
   - c) ☐ Red Cross
   - d) ☐ government laboratory
   - e) ☐ other (specify)

   ____

2. Total number of technologists working in the entire laboratory where you are presently employed.
   - a) ☐ < 10
   - b) ☐ 10-20
   - c) ☐ 21-50
   - d) ☐ 51-100
   - e) ☐ > 100

3. Location of laboratory: ____________________ (city)

   ____________________ (province)

B. R.T. CERTIFICATION PROGRAM

1. As an employer of new graduates, indicate (✓) those disciplines that you feel are adequately covered in the R.T. certification program to meet the needs in the work place:
   - a) ☐ Clinical Chemistry
   - b) ☐ Hematology
   - c) ☐ Histotechnology
   - d) ☐ Immunohematology
   - e) ☐ Clinical Microbiology

2. Check (✓) those disciplines that you feel should continue to be included in the general R.T. certification program.
   - a) ☐ Clinical Chemistry
   - b) ☐ Hematology
   - c) ☐ Histotechnology
   - d) ☐ Immunohematology
   - e) ☐ Clinical Microbiology

PROCEED TO SECTION 2

SECTION 2: GENERAL KNOWLEDGE

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY ALL EMPLOYERS.

A. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Human anatomy and physiology	○	○	☐	☐	☐
2. General genetics	○	○	☐	☐	☐
3. Molecular biology	○	○	☐	☐	☐
4. Basic concepts of immunity	○	○	☐	☐	☐
5. Introductory inorganic chemistry	○	○	☐	☐	☐
6. Introductory organic chemistry	○	○	☐	☐	☐
7. Basic physics	○	○	☐	☐	☐
8. Lab. mathematics & statistics	○	○	☐	☐	☐
9. Laboratory safety	○	○	☐	☐	☐
10. Laboratory glass & plastic ware	○	○	☐	☐	☐
11. Sterilization & disinfection	○	○	☐	☐	☐
12. Collection of specimens	○	○	☐	☐	☐
13. Laboratory records	○	○	☐	☐	☐
14. Legal aspects & the technologist	○	○	☐	☐	☐
15. Basic laboratory instrumentation	○	○	☐	☐	☐
16. Preventive maintenance	○	○	☐	☐	☐
17. Communications	○	○	☐	☐	☐

B. Additional comments on general knowledge section:

PROCEED TO SECTION 3 ➞

SECTION 3: IMMUNOHEMATOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE AN IMMUNOHEMATOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE AN IMMUNOHEMATOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 4. ⟶

A. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Factors affecting antigen-antibody reactions	○	○	☐	☐	☐
2. Inhibition/neutralization tests	○	○	☐	☐	☐
3. REAGENTS: origin, storage and ...					
a) cell suspension: preparation	○	○	☐	☐	☐
b) Rh-hr control: use	○	○	☐	☐	☐
c) Antisera: govt. regulations	○	○	☐	☐	☐
d) Bovine albumin	○	○	☐	☐	☐
e) Saline sol'n: prep., constituents	○	○	☐	☐	☐
f) Proteolytic enzymes	○	○	☐	☐	☐
4. Specificity of lectins	○	○	☐	☐	☐
5. EQUIPMENT: use & application:					
a) refrigerated centrifuge	○	○	☐	☐	☐
b) blood bank refrigerator	○	○	☐	☐	☐
c) Rh viewing box	○	○	☐	☐	☐
6. BLOOD DONATION:					
a) criteria for selection of donors	○	○	☐	☐	☐
b) procedure for collection	○	○	☐	☐	☐
c) tests done on donated blood	○	○	☐	☐	☐
d) blood components: storage and effect of storage	○	○	☐	☐	☐
e) blood components: clinical use	○	○	☐	☐	☐

B. For each blood group system below, indicate (√) those items that you feel are necessary to work effectively in Immunohematology

ITEM	Characteristics of antigens	Characteristics of antibodies	Clinical sign. of antibodies	Nomenclature	Frequency of Phenotypes	Phenotyping Procedures	Interpretation of Phenotyping Results	Use of appropriate Controls	Causes of Anomalous Results
1. ABO System	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. LEWIS System	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. RHESUS System	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. P System	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. I System	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. MNSs System	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. DUFFY System	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. KELL System	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. KIDD System	☐	☐	☐	☐	☐	☐	☐	☐	☐

C. For the following tests, indicate (√) those procedures that you routinely use in antibody detection and/or antibody identification in your immunohematology laboratory.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Saline room temperature	☐	☐	☐	☐	☐
2. LISS room temperature	☐	☐	☐	☐	☐
3. Saline 37°C	☐	☐	☐	☐	☐
4. Albumin 37°C	☐	☐	☐	☐	☐
5. LISS 37°C	☐	☐	☐	☐	☐
6. Saline indirect antiglobulin	☐	☐	☐	☐	☐
7. Albumin indirect antiglobulin	☐	☐	☐	☐	☐
8. LISS 37°C indirect antiglobulin	☐	☐	☐	☐	☐
9. one stage enzyme 37°C test	☐	☐	☐	☐	☐
10. Two stage enzyme 37°C test	☐	☐	☐	☐	☐

D. For each item below, check (✓) the appropriate responses

ITEM	1 REQUIRED FOR WORK PLACE YES	 NO	2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: NICE TO KNOW	 OFTEN NEEDED	 ESSENTIAL
1. BLOOD GROUP SYSTEMS:					
a) ABO: secretor testing	○	○	☐	☐	☐
b) LEWIS: - method of detecting antigens in secretion	○	○	☐	☐	☐
c) RHESUS: - history of Rh system	○	○	☐	☐	☐
- Fisher-Race nomenclature	○	○	☐	☐	☐
- Wiener nomenclature	○	○	☐	☐	☐
- genetic basis of Du	○	○	☐	☐	☐
- characteristics of anti-G	○	○	☐	☐	☐
d) I: characteristics of anti-HI	○	○	☐	☐	☐
e) P: characteristics of anti-P (Donath-Landsteiner antibody)	○	○	☐	☐	☐
2. DIRECT & INDIRECT ANTIGLOBULIN TESTS:					
a) principles and uses	○	○	☐	☐	☐
b) quality control	○	○	☐	☐	☐
c) performance of test	○	○	☐	☐	☐
d) interpretation of results	○	○	☐	☐	☐
e) sources of error	○	○	☐	☐	☐
f) specificity of antiglobulin sera	○	○	☐	☐	☐
g) use of monospecific sera	○	○	☐	☐	☐
h) use of polyspecific sera	○	○	☐	☐	☐

E. Does your laboratory routinely do antibody identifications ? YES ☐ NO ☐

If YES, indicate (✓) which of the following is required to work in your laboratory.

If NO, proceed to question F.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. phenotyping	☐	☐	☐	☐	☐
2. absorptions	☐	☐	☐	☐	☐
3. heat elutions	☐	☐	☐	☐	☐
4. use of 2 mercapto-ethanol	☐	☐	☐	☐	☐
5. use of dithiothreitol	☐	☐	☐	☐	☐
6. titrations	☐	☐	☐	☐	☐
7. tests at 4°C, 18°C, 30°C	☐	☐	☐	☐	☐

F. How well do you feel the new graduates are prepared to recognize the causes, the effects and the resolution of the following problems routinely encountered in the Immunohematology department ?

ITEM	TOO MUCH PREPARATION	PREPARATION OKAY	NOT ENOUGH PREPARATION	NOT PREPARED AT ALL
1. rouleaux formation	☐	☐	☐	☐
2. panagglutinins	☐	☐	☐	☐
3. polyagglutinins	☐	☐	☐	☐
4. cold autoagglutinins	☐	☐	☐	☐
5. Wharton's jelly	☐	☐	☐	☐
6. prozones	☐	☐	☐	☐
7. dosage effect	☐	☐	☐	☐
8. antigen/antibody deterioration	☐	☐	☐	☐
9. mixed field agglutination	☐	☐	☐	☐

G. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Antibody detection and/or identification:					
a) criteria for the selection of screening cells	○	○	☐	☐	☐
b) criteria for the selection of panel cells	○	○	☐	☐	☐
c) use of cold autoabsorption	○	○	☐	☐	☐
d) use of monospecific anti-IgG	○	○	☐	☐	☐
e) detection of alloantibodies	○	○	☐	☐	☐
f) specificity of autoantibodies (warm & cold)	○	○	☐	☐	☐
g) drug induced hemolytic anemia: problems	○	○	☐	☐	☐
2. Compatibility testing:					
a) verifying I.D. of the patient	○	○	☐	☐	☐
b) verifying patient specimens	○	○	☐	☐	☐
c) verifying donor units	○	○	☐	☐	☐
d) significance of the following tests:					
i) saline room temperature	○	○	☐	☐	☐
ii) LISS room temperature	○	○	☐	☐	☐
iii) saline 37°C	○	○	☐	☐	☐
iv) albumin 37°C	○	○	☐	☐	☐
v) LISS 37°C	○	○	☐	☐	☐
vi) saline indirect antiglobulin	○	○	☐	☐	☐
vii) albumin indirect antiglobulin	○	○	☐	☐	☐
viii) LISS 37°C indirect antiglobulin	○	○	☐	☐	☐
ix) one stage enzyme 37°C test	○	○	☐	☐	☐
x) two stage enzyme 37°C test	○	○	☐	☐	☐
xi) enzyme antiglobulin	○	○	☐	☐	☐
e) limitations of compatibility tests	○	○	☐	☐	☐

H. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Selecting donor blood:					
a) in routine & emergency situations	○	○	☐	☐	☐
b) when recipient's specimen is not available	○	○	☐	☐	☐
c) when group specific blood is not available	○	○	☐	☐	☐
d) N.B. of visual checking of donor units prior to issuing	○	○	☐	☐	☐
2. High incidence antibodies: problems	○	○	☐	☐	☐
3. Low incidence antibodies: problems	○	○	☐	☐	☐
4. Transfusion reactions:					
a) allo-immunization: consequences	○	○	☐	☐	☐
b) criteria used to differentiate urticarial, anaphylactic, febrile & hemolytic reactions	○	○	☐	☐	☐
c) preventive measures taken	○	○	☐	☐	☐
d) procedure for investigation	○	○	☐	☐	☐
5. Hemolytic disease of the newborn:					
a) causes and clinical symptoms	○	○	☐	☐	☐
b) investigative tests: i) prenatal	○	○	☐	☐	☐
ii) postnatal	○	○	☐	☐	☐
c) acid elution test for detection of fetal red cells in maternal circulation	○	○	☐	☐	☐
d) bile pigments in amniotic fluid: significance	○	○	☐	☐	☐
e) constituents and use of Rh immune globulin	○	○	☐	☐	☐
f) selection of donor blood: i) for exchange transfusion	○	○	☐	☐	☐
ii) for intrauterine transfusion	○	○	☐	☐	☐

SECTION 4 HEMATOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A HEMATOLOGY DEPARTMENT IN THEIR LABORATORY.
IF YOU DO NOT HAVE A HEMATOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 5 ⟶

A. For each method below, indicate (✓) what a new graduate needs to know to work effectively in Hematology.

METHODS	SELECTION OF ANTICOAGULANTS	COLLECTION & HANDLING OF SPECIMENS	PREPARATION OF REAGENTS	APPLICATION OF TEST	PERFORMANCE OF TEST	USE OF CONTROLS	SOURCES OF ERROR	NORMAL RANGE	SIGNIFICANCE OF ABNORMAL VALUES
1. hemoglobin determination (manual)	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. RBC count (automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Hematocrit (manual and automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Indices	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Reticulocyte count	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. ESR: Wintrobe method	☐	☐	☐	☐	☐	☐	☐	☐	☐
Westergren method	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Osmotic fragility test	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. WBC count (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Microscopic sickling test	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Solubility test (Hgb S)	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. WBC differential count	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Corrected WBC count	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Platelet count (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Buffy coat preparation	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. CSF leukocyte count	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. CSF differential WBC count	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Preparation of slides for staining	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Template bleeding time	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Clot retraction	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. One-stage prothrombin time (manual and automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. APTT (manual & automated)	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Thrombin time	☐	☐	☐	☐	☐	☐	☐	☐	☐

B. For the following peripheral blood cells and their precursors in the bone marrow, indicate (✓) what the NEW graduate needs to know for the work place.

ITEM	REQUIRED IN THE WORK PLACE			
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Peripheral blood: a) erythrocytes	☐	☐	☐	☐
b) leukocytes: mature granulocytes	☐	☐	☐	☐
lymphocytes	☐	☐	☐	☐
monocytes	☐	☐	☐	☐
c) platelets	☐	☐	☐	☐
2. Bone marrow precursors: a) blast cells	☐	☐	☐	☐
b) RBC: pronormoblast	☐	☐	☐	☐
basophilic normoblast	☐	☐	☐	☐
polychromatic normoblast	☐	☐	☐	☐
orthochromatic normoblast	☐	☐	☐	☐
c) WBC: promyelocyte	☐	☐	☐	☐
myelocyte	☐	☐	☐	☐
metamyelocyte	☐	☐	☐	☐
band cell	☐	☐	☐	☐
immature monocyte, and lymphocyte	☐	☐	☐	☐
d) megakaryocyte	☐	☐	☐	☐

C. For each staining method below, indicate (✓) the appropriate response.

STAINS	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:			
	YES	NO	APPLICATION	PROCEDURE	PREPARATION OF REAGENTS	PRINCIPLE OF STAIN
1. Romanowsky stains: Wright's	○	○	☐	☐	☐	☐
Giemsa	○	○	☐	☐	☐	☐
2. Perls' Prussian blue reaction	○	○	☐	☐	☐	☐
3. Supravital stain (reticulocytes)	○	○	☐	☐	☐	☐
4. Heinz body stain	○	○	☐	☐	☐	☐

- 3 -

D. For each instrument below, indicate (✓) what a new graduate should know for the work place.

INSTRUMENTS	PRINCIPLE OF OPERATION	APPLICATION & USE	CALIBRATION	ROUTINE MAINTENANCE
1. Electronic cell counters	☐	☐	☐	☐
2. Hemoglobinometers	☐	☐	☐	☐
3. Automatic slide stainers	☐	☐	☐	☐
4. Coagulation timers	☐	☐	☐	☐
5. Microhematocrit centifuges	☐	☐	☐	☐

E. For each item below, indicate (✓) the appropriate response.

ITEM	REQUIRED IN THE WORK PLACE			
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
HEMOPOIESIS				
1. Role of bone marrow	☐	☐	☐	☐
2. Role of liver	☐	☐	☐	☐
3. Role of spleen	☐	☐	☐	☐
4. Role of lymph nodes	☐	☐	☐	☐
5. Sequential development of erythrocytes	☐	☐	☐	☐
6. Sequential development of leukocytes	☐	☐	☐	☐
7. Sequential development of megakaryocytes	☐	☐	☐	☐
8. Dietary requirements	☐	☐	☐	☐
9. Regulatory hormones	☐	☐	☐	☐
10. Life span of erythrocytes	☐	☐	☐	☐
11. Life span of leukocytes	☐	☐	☐	☐
12. Life span of platelets	☐	☐	☐	☐
13. Hemoglobin degradation	☐	☐	☐	☐
14. Hemoglobin excretion	☐	☐	☐	☐
15. Platelet role in hemostasis	☐	☐	☐	☐
16. Erythrocyte role in gas transport	☐	☐	☐	☐
17. Leukocyte role in phagocytosis	☐	☐	☐	☐

F. For each blood dyscrasia below, indicate (✓) the knowledge required in the work place by the new graduate.

BLOOD DYSCRASIAS	REQUIREMENT IN THE WORK PLACE				
	NOT REQUIRED	SIGNIFICANCE	PERIPHERAL BLOOD PICTURE	BONE MARROW PICTURE	ADDITIONAL TESTS
1. Post hemorrhagic anemia	☐	☐	☐	☐	☐
2. Iron deficiency anemia	☐	☐	☐	☐	☐
3. Megaloblastic anemia	☐	☐	☐	☐	☐
4. Hereditary spherocytosis	☐	☐	☐	☐	☐
5. Sickle cell anemia	☐	☐	☐	☐	☐
6. Thalassemia (major & minor)	☐	☐	☐	☐	☐
7. Aplastic anemia	☐	☐	☐	☐	☐
8. Acute/chronic granulocytic leukemia	☐	☐	☐	☐	☐
9. Acute/chronic lymphatic leukemia	☐	☐	☐	☐	☐
10. Acute monocytic leukemia	☐	☐	☐	☐	☐
11. Polycythemia (primary & secondary)	☐	☐	☐	☐	☐
12. Multiple myeloma	☐	☐	☐	☐	☐
13. Infectious mononucleosis	☐	☐	☐	☐	☐
14. Lupus erythematosus	☐	☐	☐	☐	☐

G. Does your laboratory routinely do coagulation studies ? YES ☐ NO ☐

If YES, indicate (✓) which of the following are required to work in your laboratory.

If NO, proceed to Question H ⟶

TESTS	NOT REQUIRED	SPECIMEN FOR TEST	PERFORMANCE OF TEST	USE OF CONTROLS	SOURCES OF ERROR	SIGNIFICANCE OF RESULTS
1. Prothrombin correction test	☐	☐	☐	☐	☐	☐
2. APTT correction test	☐	☐	☐	☐	☐	☐
3. Factor XIII screening test	☐	☐	☐	☐	☐	☐
4. Fibrinolysin detection: a) euglobulin lysis	☐	☐	☐	☐	☐	☐
b) fibrin and FDP	☐	☐	☐	☐	☐	☐
5. Tests for circulating antibodies	☐	☐	☐	☐	☐	☐

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H. With regard to abnormal blood cell morphology, indicate (✓) all that is required to work effectively in the Hematology department.

ABNORMAL BLOOD CELL MORPHOLOGY	REQUIREMENT IN THE WORK PLACE		
	NOT REQUIRED	APPEARANCE	SIGNIFICANCE
1. Hypochromia	☐	☐	☐
2. Polychromasia	☐	☐	☐
3. Anisocytosis	☐	☐	☐
4. Poikilocytosis	☐	☐	☐
5. Microcytosis	☐	☐	☐
6. Macrocytosis	☐	☐	☐
7. Spherocytosis	☐	☐	☐
8. Ovalocytosis	☐	☐	☐
9. Burr cells	☐	☐	☐
10. Schistocytes	☐	☐	☐
11. Target cells	☐	☐	☐
12. Sickle cells	☐	☐	☐
13. Crenated cells	☐	☐	☐
14. Malarial parasites	☐	☐	☐
15. Stomatocytes	☐	☐	☐
16. Acanthocytes	☐	☐	☐
17. Red cell inclusions	☐	☐	☐
18. White cell inclusions	☐	☐	☐
19. Auer rods	☐	☐	☐
20. Hypersegmentation	☐	☐	☐
21. Pelger-Huet anomaly	☐	☐	☐
22. Leukopenia/Leukocytosis	☐	☐	☐
23. Thrombocytopenia/Thrombocytosis	☐	☐	☐
24. Atypical Lymphocytes	☐	☐	☐
25. Smudge cells	☐	☐	☐

SECTION 5: CLINICAL MICROBIOLOGY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A MICROBIOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A MICROBIOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 6 ⟶

A. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Characteristics of bacteria:					
a) nuclear structure	○	○	☐	☐	☐
b) cytoplasmic structure	○	○	☐	☐	☐
c) cell wall composition	○	○	☐	☐	☐
d) flagella	○	○	☐	☐	☐
e) method: nuclear division	○	○	☐	☐	☐
f) relationship with plant/animal kingdom	○	○	☐	☐	☐
g) bacterial growth curve	○	○	☐	☐	☐
h) morphology of bacterial colonies	○	○	☐	☐	☐
2. Anatomy of eubacterial cell	○	○	☐	☐	☐
3. Culture media: prep. & storage					
a) blood agar plates	○	○	☐	☐	☐
b) tube slanted media	○	○	☐	☐	☐
c) medium with heat sensitive ingredient	○	○	☐	☐	☐
d) checking/adjusting of pH	○	○	☐	☐	☐
e) criteria for pH 7 Eh indicators	○	○	☐	☐	☐
f) storage of dehydrated/prepared media	○	○	☐	☐	☐
4. Function & ingredients of:					
a) blood agar	○	○	☐	☐	☐
b) fluid media for primary culture	○	○	☐	☐	☐
c) differential media	○	○	☐	☐	☐
d) selective media	○	○	☐	☐	☐
e) transport media	○	○	☐	☐	☐

8. For the following differential procedures, indicate (✓) what is needed to work effectively in clinical microbiology.

DIFFERENTIAL PROCEDURES	PRINCIPLE	APPLICATION	INTERPRETATION	PERFORMANCE OF TEST	USE OF CONTROLS
1. Catalase test	☐	☐	☐	☐	☐
2. Slide/tube coagulase test	☐	☐	☐	☐	☐
3. Hemolysis on blood agar plates	☐	☐	☐	☐	☐
4. Bacitracin susceptibility	☐	☐	☐	☐	☐
5. Optochin sensitivity	☐	☐	☐	☐	☐
6. Bile solubility	☐	☐	☐	☐	☐
7. Esculin hydolysis	☐	☐	☐	☐	☐
8. Growth on 40% bile agar	☐	☐	☐	☐	☐
9. Growth in 6.5% NaCl broth	☐	☐	☐	☐	☐
10. Oxidase test	☐	☐	☐	☐	☐
11. Carbohydrate fermentation	☐	☐	☐	☐	☐
12. Triple sugar iron (TSI) agar	☐	☐	☐	☐	☐
13. Methylene red (MR) test	☐	☐	☐	☐	☐
14. Voges-Proskauer test	☐	☐	☐	☐	☐
15. ONPG test	☐	☐	☐	☐	☐
16. Indole production	☐	☐	☐	☐	☐
17. Urease test	☐	☐	☐	☐	☐
18. Simmons' citrate test	☐	☐	☐	☐	☐
19. Decarboxylase tests	☐	☐	☐	☐	☐
20. Phenylalanine deaminase test	☐	☐	☐	☐	☐
21. Nitrate/nitrite reduction	☐	☐	☐	☐	☐
22. Gelatinase test	☐	☐	☐	☐	☐
23. Pigment production	☐	☐	☐	☐	☐
24. H_2S production in TSI agar	☐	☐	☐	☐	☐
25. Motility	☐	☐	☐	☐	☐
26. X & V factor growth requirements	☐	☐	☐	☐	☐

C. For the following organisms, check (✓) what the new graduate needs to know to work effectively in clinical microbiology.

ORGANISMS	CELLULAR MORPHOLOGY	STAINING REACTIONS	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCE OF INFECTION	PATHOGENICITY	COLONIAL MORPHOLOGY	ISOLATION PROCEDURES	IDENTIFICATION PROCEDURES
1. Staphylococcus aureus	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Staphylococcus epidermidis	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Micrococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Streptococcus pyogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Viridans group	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Enterococcus group	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Streptococcus pneumoniae	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Streptococci (groups B, C, & G)	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Peptococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Peptostreptococcus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Lactobacillus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Corynebacterium diphtheriae	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Diphtheroids	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Actinomyces israelii	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Nocardia asteroides	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Mycobacterium tuberculosis	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Listeria monocytogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Bacillus anthracis	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Bacillus species	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Clostridium perfringens	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Clostridium tetani	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Clostridium botulinum	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Neisseria gonorrhoeae	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Neisseria meningitidis	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Neisseria lactamica	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. Branhamella catarrhalis	☐	☐	☐	☐	☐	☐	☐	☐	☐
27. Acinetobacter species	☐	☐	☐	☐	☐	☐	☐	☐	☐

D. For the following organisms, check (✓) what the new graduate needs to know to work effectively in clinical microbiology.

ORGANISMS	CELLULAR MORPHOLOGY	STAINING REACTIONS	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCE OF INFECTION	PATHOGENICITY	COLONIAL MORPHOLOGY	ISOLATION PROCEDURES	IDENTIFICATION PROCEDURES
1. Escherichia coli	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Edwardsiella tarda	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Citrobacter species	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Salmonella typhi	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Salmonella arizonae	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Salmonella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Shigella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Klebsiella species	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Enterobacter cloacae	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Enterobacter aerogenes	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Hafnia alvei	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Serratia marcescens	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Proteus mirabilis	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Yersinia enterocolitica	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Vibrio	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Aeromonas	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Haemophilus influenzae	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Gardnerella (haemophilis) vaginalis	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Pasteurella multocida	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Pseudomonas aeruginosa	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Alcaligenes species	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Brucella abortus	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Bordetella pertussis	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Bacteroides species	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Treponema pallidum	☐	☐	☐	☐	☐	☐	☐	☐	☐

E. For each clinical specimen below, check (✓) those items required for proper examination of specimen in the work place.

CLINICAL SPECIMENS	SAFETY PRECAUTIONS	SUITABILITY OF SPECIMEN	MACROSCOPIC EXAMINATION	MICROSCOPIC EXAMINATION	APPROPRIATE MEDIA	INOCULATION OF PRIMARY ISOLATION MEDIA	TESTS FOR IDENTIFICATION	NEED FOR PRELIMINARY REPORT
1. Blood culture	☐	☐	☐	☐	☐	☐	☐	☐
2. CSF	☐	☐	☐	☐	☐	☐	☐	☐
3. Effusions	☐	☐	☐	☐	☐	☐	☐	☐
4. Biopsied tissue	☐	☐	☐	☐	☐	☐	☐	☐
5. Surgical wounds	☐	☐	☐	☐	☐	☐	☐	☐
6. Urine	☐	☐	☐	☐	☐	☐	☐	☐
7. Faces	☐	☐	☐	☐	☐	☐	☐	☐
8. Sputum	☐	☐	☐	☐	☐	☐	☐	☐
9. Swab from ear	☐	☐	☐	☐	☐	☐	☐	☐
10. Swab from nose	☐	☐	☐	☐	☐	☐	☐	☐
11. Swab from throat	☐	☐	☐	☐	☐	☐	☐	☐
12. Swab from nasopharynx	☐	☐	☐	☐	☐	☐	☐	☐
13. Swab from skin	☐	☐	☐	☐	☐	☐	☐	☐
14. Swab from genital tract	☐	☐	☐	☐	☐	☐	☐	☐

F. Does your laboratory routinely do mycology? Yes ☐ No ☐

If YES, indicate (✓) which of the following is required to work effectively in your laboratory.

If NO, proceed to question G ——→

YEAST-LIKE FUNGI	GROWTH REQUIREMENTS	NATURAL HABITAT	SOURCES OF INFECTION	PATHOGENICITY	DIFFERENTIATION OF ORGANISM
1. Candida albicans	☐	☐	☐	☐	☐
2. Other Candida species	☐	☐	☐	☐	☐
3. Cryptococcus neoformans	☐	☐	☐	☐	☐
4. Other cryptococcus species	☐	☐	☐	☐	☐
5. Torulopsis glabrata	☐	☐	☐	☐	☐

G. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE: YES	1 REQUIRED FOR WORK PLACE: NO	2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Quality control: sterility testing	○	○	☐	☐	☐
2. Culturing:					
a) Streaking petri plate media	○	○	☐	☐	☐
b) Transfering bacteria by wire loop/needle	○	○	☐	☐	☐
c) Accurate pipetting of bacterial suspensions	○	○	☐	☐	☐
d) Inoculation of broth cultures	○	○	☐	☐	☐
e) Selective cultivation of micro-organisms	○	○	☐	☐	☐
f) Viable counts using loop technique	○	○	☐	☐	☐
g) Use of dipslides	○	○	☐	☐	☐
h) Anaerobic culturing using anaerobic jar	○	○	☐	☐	☐
i) Use of Eh indicators	○	○	☐	☐	☐
j) Culturing in CO_2 atmosphere	○	○	☐	☐	☐
k) Preservation of stock cultures	○	○	☐	☐	☐
3. Blood cultures: a) collection of specimens	○	○	☐	☐	☐
b) subculturing	○	○	☐	☐	☐
c) incubation periods					
4. Cerebrospinal fluid:					
a) significance of presence of WBC cells	○	○	☐	☐	☐
5. Respiratory Tract:					
a) technique for liquefaction of sputum	○	○	☐	☐	☐
b) microscopic appearance of Vincent's infection	○	○	☐	☐	☐
6. Microscopic examination					
a) wet preparations for motility	○	○	☐	☐	☐
b) use of Gram stain	○	○	☐	☐	☐

H. For each item below, check (√) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
Antimicrobial susceptibility testing					
1. Bacteriostatic activity	○	○	☐	☐	☐
2. Bactericidal activity	○	○	☐	☐	☐
3. Antimicrobial spectrum of antibodies	○	○	☐	☐	☐
4. Use of Kirby-Bauer technique:					
a) prep. of MacFarland $BaSO_4$ standard	○	○	☐	☐	☐
b) prep./standardization of inoculum	○	○	☐	☐	☐
c) use of Mueller-Hinton agar	○	○	☐	☐	☐
d) preparation/inoculation of agar plates	○	○	☐	☐	☐
e) reading/interpretation of results	○	○	☐	☐	☐
f) storage of discs	○	○	☐	☐	☐
g) limitations of the technique	○	○	☐	☐	☐
5. Detection of B-lactamase production	○	○	☐	☐	☐
6. Principle of the Schlichter test (serum bactericidal level)	○	○	☐	☐	☐
7. Parasitology					
a) use of Scotch ® tape preparations	○	○	☐	☐	☐
b) morphology of pinworm eggs	○	○	☐	☐	☐
c) wet mounts for Trichomonas vaginalis	○	○	☐	☐	☐
8. Active immunization:					
a) use of live attenuated vaccines	○	○	☐	☐	☐
b) use of killed vaccines	○	○	☐	☐	☐
c) use of toxoids	○	○	☐	☐	☐
9. Passive immunization					
a) use of antitoxins	○	○	☐	☐	☐

I. For each serological method below, check (✓) what information a new graduate needs to know to work in clinical microbiology.

SEROLOGICAL METHODS	PRINCIPLE	APPLICATION	INTERPRETATION	PERFORMANCE OF TEST	USE OF CONTROLS
1. Slide agglutination tests (for enteropathogenic E. Coli)	☐	☐	☐	☐	☐
2. Lancefield grouping	☐	☐	☐	☐	☐
3. Nagler reaction	☐	☐	☐	☐	☐
4. Elek test	☐	☐	☐	☐	☐

J. For the following tests, indicate (✓) the appropriate responses.

TESTS	REQUIREMENT IN THE WORK PLACE					
	NOT REQUIRED	NATURE OF ANTIGEN	INCUBATION TIME	INACTIVATION OF SERUM (IF NECESSARY)	READING/REPORTING OF RESULTS	USE OF CONTROLS
1. Screen test for heterophile antibody	☐	☐	☐	☐	☐	☐
2. Anti-streptolysin O titration (ASO)	☐	☐	☐	☐	☐	☐
3. Widal agglutination test	☐	☐	☐	☐	☐	☐
4. Brucella agglutination test	☐	☐	☐	☐	☐	☐

SECTION 6: CLINICAL CHEMISTRY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A CHEMISTRY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A CHEMISTRY DEPARTMENT IN YOUR LABORATORY, PROCEED TP SECTION 7 ⟶

A. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Carbohydrates:					
a) differentiate between mono-, di- and poly- saccharides	○	○	☐	☐	☐
b) reducing vs non-reducing sugar	○	○	☐	☐	☐
c) carbohydrate metabolism	○	○	☐	☐	☐
d) oral glucose tolerance test	○	○	☐	☐	☐
e) 2 hour p.c. blood sugar	○	○	☐	☐	☐
2. Lipids: a) solubility characteristics	○	○	☐	☐	☐
b) simple vs compound lipid	○	○	☐	☐	☐
c) structure of cholesterol	○	○	☐	☐	☐
d) structure of triglycerides	○	○	☐	☐	☐
e) fatty acid oxidation	○	○	☐	☐	☐
3. Proteins: describe ...					
a) primary structure	○	○	☐	☐	☐
b) secondary structure	○	○	☐	☐	☐
c) tertiary structure	○	○	☐	☐	☐
d) amphoteric properties of proteins	○	○	☐	☐	☐
e) five major protein groups (separated by electrophoresis)	○	○	☐	☐	☐
4. Non-protein Nitrogenous Substances:					
a) formation/excretion of: a) urea	○	○	☐	☐	☐
b) creatinine	○	○	☐	☐	☐
c) uric acid	○	○	☐	☐	☐

B. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Acid-base & Electrolytes:					
a) control of blood pH by buffer systems	○	○	☐	☐	☐
b) regulation of pH by renal system	○	○	☐	☐	☐
c) regulation of pH by respiratory system	○	○	☐	☐	☐
d) use of Henderson-Hasselbalch equation	○	○	☐	☐	☐
e) hemoglobin as an oxygen carrier	○	○	☐	☐	☐
f) anions and cations in blood	○	○	☐	☐	☐
g) metabolism of electrolytes	○	○	☐	☐	☐
h) osmolality	○	○	☐	☐	☐
2. Enzymes: a) general structure	○	○	☐	☐	☐
b) catalytic properties	○	○	☐	☐	☐
c) classification	○	○	☐	☐	☐
d) enzyme activity: what effects?	○	○	☐	☐	☐
e) measurements: endpoint vs kinetic types	○	○	☐	☐	☐
f) define isoenzyme	○	○	☐	☐	☐
3. Ligand Assay: a) principle	○	○	☐	☐	☐
b) basic concepts of: - CPB	○	○	☐	☐	☐
- FIA	○	○	☐	☐	☐
- EIA	○	○	☐	☐	☐
4. Liver Function: a) role of liver in:					
- carbohydrate metabolism	○	○	☐	☐	☐
- protein metabolism	○	○	☐	☐	☐
- lipid metabolism	○	○	☐	☐	☐
- detoxification	○	○	☐	☐	☐
- bilirubin metabolism	○	○	☐	☐	☐

C. For each method below, indicate (✓) what you feel you need to know as a new graduate to work effectively in Clinical Chemistry.

SELECTED METHODS	SELECTION OF ANTICOAGULANT	COLLECTION & HANDLING OF SPECIMENS	PREPARATION OF REAGENTS	PRINCIPLE & PROCEDURE	CALCULATING & REPORTING RESULTS	REFERENCE VALUES	SOURCES OF ERROR	SIGNIFICANCE OF ABNORMAL RESULTS
1. Glucose: a) hexokinase	☐	☐	☐	☐	☐	☐	☐	☐
b) glucose oxidase	☐	☐	☐	☐	☐	☐	☐	☐
2. Cholesterol: enzymatic method	☐	☐	☐	☐	☐	☐	☐	☐
3. Proteins: a) biuret reaction	☐	☐	☐	☐	☐	☐	☐	☐
b) dye binding (albumin)	☐	☐	☐	☐	☐	☐	☐	☐
c) electrophoresis	☐	☐	☐	☐	☐	☐	☐	☐
4. Urea: a) diacetyl monoxime method	☐	☐	☐	☐	☐	☐	☐	☐
b) urease method	☐	☐	☐	☐	☐	☐	☐	☐
c) conductance electrode	☐	☐	☐	☐	☐	☐	☐	☐
5. Creatinine: Jaffé reaction	☐	☐	☐	☐	☐	☐	☐	☐
6. Acid-base: pO, pCO_2, CO_2 and pH:								
a) direct electrode method	☐	☐	☐	☐	☐	☐	☐	☐
b) CO_2: automated method	☐	☐	☐	☐	☐	☐	☐	☐
7. Sodium & Potassium:								
a) flame photometry	☐	☐	☐	☐	☐	☐	☐	☐
b) ion-selective electrode	☐	☐	☐	☐	☐	☐	☐	☐
8. Chloride: chloridometer	☐	☐	☐	☐	☐	☐	☐	☐
9. Calcium: a) atomic absorption	☐	☐	☐	☐	☐	☐	☐	☐
b) o-cresophthalein complexone	☐	☐	☐	☐	☐	☐	☐	☐
10. Phosphorus: method involving reduction of molybdenum blue	☐	☐	☐	☐	☐	☐	☐	☐
11. Alkaline phosphatase:								
a) p-nitrophenylphosphate	☐	☐	☐	☐	☐	☐	☐	☐
12. Bilirubin: Jendrassik & Groff	☐	☐	☐	☐	☐	☐	☐	☐
13. Toxicology: Salicylate determination	☐	☐	☐	☐	☐	☐	☐	☐

D. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Renal function: a) role of the kidney in:					
- excretion of waste products	○	○	☐	☐	☐
- osmoregulation	○	○	☐	☐	☐
- acid-base/electrolyte regulation	○	○	☐	☐	☐
2. Evaluation of renal function by:					
- osmolality	○	○	☐	☐	☐
- specific gravity	○	○	☐	☐	☐
- creatinine clearance	○	○	☐	☐	☐
3. Pregnancy test: a) principle	○	○	☐	☐	☐
b) limitations	○	○	☐	☐	☐
c) sources of error	○	○	☐	☐	☐
4. Statistics: a) terminology	○	○	☐	☐	☐
b) Gaussian distribution	○	○	☐	☐	☐
c) non-Gaussian distribution	○	○	☐	☐	☐
5. Reference interval (normal values):					
a) calculation	○	○	☐	☐	☐
b) need to establish for lab	○	○	☐	☐	☐
c) effects of physiological variables	○	○	☐	☐	☐
6. Laboratory Application of quality control:					
a) primary vs secondary standards	○	○	☐	☐	☐
b) standards vs controls	○	○	☐	☐	☐
c) commercial controls vs in-house pools	○	○	☐	☐	☐
d) prep. & use: - stock standards	○	○	☐	☐	☐
- working standards	○	○	☐	☐	☐
e) for methods: - specificity	○	○	☐	☐	☐
- sensitivity	○	○	☐	☐	☐
- allowable limits of error	○	○	☐	☐	☐
f) prep. of quality control charts	○	○	☐	☐	☐

E. For each instrument below, indicate (✓) all that is required by a new graduate to work effectively in clinical chemistry.

INSTRUMENTS	REQUIREMENT IN THE WORK PLACE		
	NOT REQUIRED	PRINCIPLE	APPLICATION
1. Continuous flow analyzer	☐	☐	☐
2. Centrifugal analyzer	☐	☐	☐
3. Discrete analyzer	☐	☐	☐
4. Fluorometer	☐	☐	☐
5. Atomic absorption spectrophotometer	☐	☐	☐
6. Flame photometer	☐	☐	☐
7. Densitometer	☐	☐	☐
8. Osmometer	☐	☐	☐
9. Chloridometer	☐	☐	☐
10. Nephelometer	☐	☐	☐
11. Refractometer	☐	☐	☐

F. For each item below, indicate (✓) the depth of knowledge of spectrophotometry required in the work place.

ITEM	REQUIRED IN THE WORK PLACE			
	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Monochromators: principle, application and limitations	○	○	○	○
2. Light sources: uses	○	○	○	○
3. Cuvettes: types	○	○	○	○
4. Photodetectors: principle/uses of:				
a) barrier layer cell	○	○	○	○
b) photoemissive tube	○	○	○	○
c) photomultiplier tube	○	○	○	○
5. Function of: a) galvanometer	○	○	○	○
b) potentiometer	○	○	○	○
6. Checking wavelength calibration	○	○	○	○

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G. For each specimen below, indicate (✓) the tests and methods that a new graduate needs to know in the work place.

SPECIMEN	REQUIREMENT IN THE WORK PLACE		
	NOT REQUIRED	PERFORMANCE OF THE TEST	SIGNIFICANCE
1. Urine: a) routine analysis:			
- color	☐	☐	☐
- pH	☐	☐	☐
- specific gravity	☐	☐	☐
- protein	☐	☐	☐
- glucose	☐	☐	☐
- bile pigments	☐	☐	☐
- blood	☐	☐	☐
- ketones	☐	☐	☐
- microscopic examination	☐	☐	☐
2. Urine: b) special tests:			
- urobilinogen	☐	☐	☐
- porphobilinogen	☐	☐	☐
- Bence-Jones protein	☐	☐	☐
- for cystine	☐	☐	☐
- phenylpyruvic acid	☐	☐	☐
3. Feces: a) macroscopic appearance	☐	☐	☐
b) tests for: - occult blood	☐	☐	☐
- fecal fat	☐	☐	☐
- bile/urobilinogen	☐	☐	☐
4. CSF: a) estimation of a) protein	☐	☐	☐
b) glucose	☐	☐	☐
b) clin. significance of results	☐	☐	☐
5. Gastric Analysis:			
a) principle of tube method	☐	☐	☐
b) method to determine acidity	☐	☐	☐

SECTION 7: HISTOTECHNOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A HISTOTECHNOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A HISTOTECHNOLOGY DEPARTMENT IN YOUR LABORATORY, OMIT THIS SECTION.

A. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Normal histology of primary tissues:					
a) epithelium	○	○	☐	☐	☐
b) connective tissue	○	○	☐	☐	☐
c) muscle tissue	○	○	☐	☐	☐
d) nervous tissue	○	○	☐	☐	☐
2. Fixation:					
a) purpose	○	○	☐	☐	☐
b) effect on tissue components	○	○	☐	☐	☐
c) effects of autolysis & putrefaction	○	○	☐	☐	☐
d) effect of heat, vacuum & agitation	○	○	☐	☐	☐
3. Infiltration with paraffin:					
a) characteristics of commercial paraffin	○	○	☐	☐	☐
b) use of vacuum infiltration	○	○	☐	☐	☐
4. Processing equipment: operation, advantages & disadvantages of:					
a) Autotechnicon® type	○	○	☐	☐	☐
b) fluid exchange	○	○	☐	☐	☐
5. Embedding:					
a) use of embedding equipment	○	○	☐	☐	☐
b) practical orientation of tissue	○	○	☐	☐	☐
c) sources of error	○	○	☐	☐	☐
d) corrective procedures	○	○	☐	☐	☐

B. For each fixative agent and compound fixative, indicate (√) what a new graduate needs to know to function effectively in Histotechnology.

ITEM	THEORY	USES	ADVANTAGES	DISADVANTAGES
1. Formaldehyde	☐	☐	☐	☐
2. Mercuric chloride	☐	☐	☐	☐
3. Potassium dichromate	☐	☐	☐	☐
4. Picric Acid	☐	☐	☐	☐
5. Osmium tetroxide	☐	☐	☐	☐
6. Ethanol	☐	☐	☐	☐
7. N.B.F.S.	☐	☐	☐	☐
8. Zenker's	☐	☐	☐	☐
9. Helly's	☐	☐	☐	☐
10. Bouin's	☐	☐	☐	☐

C. In decalcification, indicate (√) what a new graduate needs to know to function effectively in Histotechnology.

ITEM	PRINCIPLE	USE	ADVANTAGES	DISADVANTAGES
1. Formic Acid	☐	☐	☐	☐
2. Nitric Acid	☐	☐	☐	☐
3. EDTA	☐	☐	☐	☐
4. Tests for endpoint:				
a) chemical	☐	☐	☐	☐
b) radiological	☐	☐	☐	☐
c) physical probing	☐	☐	☐	☐

D. For each item below, indicate (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Microtome knives:					
a) how many degrees is: i) wedge angle	○	○	☐	☐	☐
ii) clearance angle	○	○	☐	☐	☐
b) definition of cutting facet	○	○	☐	☐	☐
2. Automatic knife sharpeners:					
a) routine maintenance	○	○	☐	☐	☐
b) relevance of abrasive particle size to:					
i) honing (coarse)	○	○	☐	☐	☐
ii) stropping (fine)	○	○	☐	☐	☐
3. Rotary microtome: a) operation	○	○	☐	☐	☐
b) importance of clearance angle	○	○	☐	☐	☐
c) routine maintenance	○	○	☐	☐	☐
4. Dye chemistry: understanding . . .					
a) resonance systems	○	○	☐	☐	☐
b) dye structure terminology:					
i) chromophore	○	○	☐	☐	☐
ii) chromogen	○	○	☐	☐	☐
iii) auxochrome	○	○	☐	☐	☐
c) acid, base & neutral dyes and their staining properties	○	○	☐	☐	☐
d) physical theory of staining	○	○	☐	☐	☐
e) chemical theory of staining:					
i) salt linkage	○	○	☐	☐	☐
ii) hydrogen bond	○	○	☐	☐	☐
iii) metachromasia	○	○	☐	☐	☐
iv) metallic impregnation	○	○	☐	☐	☐

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E. For each item below, check (✓) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Paraffin sectioning:					
a) effect of block temp. on sections	○	○	☐	☐	☐
b) effect of cutting speed on sections	○	○	☐	☐	☐
c) common cutting faults: recognition, causes and remedies	○	○	☐	☐	☐
d) floating out sections: purpose	○	○	☐	☐	☐
e) advantages/disadvantages of adding section adhesives to: i) water bath	○	○	☐	☐	☐
ii) slides	○	○	☐	☐	☐
f) serial sectioning: use & practice	○	○	☐	☐	☐
g) step sectioning: use & practice	○	○	☐	☐	☐
2. Staining practices:					
a) proper storage of dyes	○	○	☐	☐	☐
b) relevance of color index numbers	○	○	☐	☐	☐
c) principle & application of:					
i) progressive/regressing staining	○	○	☐	☐	☐
ii) acid differentiation	○	○	☐	☐	☐
iii) mordant differentiation	○	○	☐	☐	☐
iv) decolorization	○	○	☐	☐	☐
v) direct staining	○	○	☐	☐	☐
vi) indirect staining	○	○	☐	☐	☐
vii) use of accentuators	○	○	☐	☐	☐
viii) argyrophil reaction	○	○	☐	☐	☐
ix) argentaffin reaction	○	○	☐	☐	☐

F. For each item below, indicate (/) the appropriate responses.

ITEM	1 REQUIRED FOR WORK PLACE		2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS:		
	YES	NO	NICE TO KNOW	OFTEN NEEDED	ESSENTIAL
1. Cryostat:					
a) use o' anti-roll device	○	○	☐	☐	☐
b) disinfection	○	○	☐	☐	☐
c) routine maintenance	○	○	☐	☐	☐
d) procedure and practice for:					
i) cutting unfixed tissue	○	○	☐	☐	☐
ii) cutting fixed tissue	○	○	☐	☐	☐
e) cause & appearance of ice crystal artifact	○	○	☐	☐	☐
f) rapid H & E stain: procedure	○	○	☐	☐	☐
g) polychrome methylene blue stain: procedure	○	○	☐	☐	☐
h) use of cryostat sections for:					
i) lipid stains	○	○	☐	☐	☐
ii) demonstrating enzymes	○	○	☐	☐	☐
3. Dewaxing paraffin sections	○	○	☐	☐	☐
4. Hydrating paraffin sections	○	○	☐	☐	☐
5. Removal of fixation artifacts	○	○	☐	☐	☐
6. Celloidin coating sections	○	○	☐	☐	☐
7. Coverslipping using:					
a) resinous mountants	○	○	☐	☐	☐
b) aqueous mountants	○	○	☐	☐	☐
8. Refractive index of mounting media	○	○	☐	☐	☐

G. For each specific staining method below, indicate (✓) what a new graduate needs to know to work effectively in Histotechnology.

ITEM	THEORY	PREPARATION OF REAGENTS	PRACTISE	EVALUATION OF RESULTS	CORRECTIVE ACTION	CHOOSING CONTROL TISSUE	SAFETY PRECAUTIONS
1. Hematoxylin & Eosin	☐	☐	☐	☐	☐	☐	☐
2. Masson trichrome	☐	☐	☐	☐	☐	☐	☐
3. Weigert van Gieson	☐	☐	☐	☐	☐	☐	☐
4. Silver impregnation for reticulin	☐	☐	☐	☐	☐	☐	☐
5. P.A.S. (Periodic Acid Schiff)	☐	☐	☐	☐	☐	☐	☐
6. P.A.S. with diastase control	☐	☐	☐	☐	☐	☐	☐
7. Perls' Prussian Blue	☐	☐	☐	☐	☐	☐	☐
8. Argentaffin method for melanin	☐	☐	☐	☐	☐	☐	☐
9. Modified Gram stain	☐	☐	☐	☐	☐	☐	☐
10. Ziehl-Neelsen	☐	☐	☐	☐	☐	☐	☐
11. Gomori's methenamine silver	☐	☐	☐	☐	☐	☐	☐
12. Oil Red O	☐	☐	☐	☐	☐	☐	☐
13. Luxol fast blue/cresyl echt violet	☐	☐	☐	☐	☐	☐	☐

H. In paraffin processing, indicate (✓) what the new graduate needs to know regarding each dehydration agent and clearing agent.

ITEM		USES	ADVANTAGES	DISADVANTAGES	CORRECTIVE PROCEDURE
1. DEHYDRATION AGENTS:	a) ethanol	☐	☐	☐	☐
	b) isopropanol	☐	☐	☐	☐
	c) acetone	☐	☐	☐	☐
2. CLEARING AGENTS:	a) xylene	☐	☐	☐	☐
	b) toluene	☐	☐	☐	☐
	c) chloroform	☐	☐	☐	☐

APPENDIX G

R.T. CERTIFICATION EXAMINATION RESULTS

1979-1984

CANADIAN SOCIETY OF LABORATORY TECHNOLOGISTS
R.T. INITIAL CERTIFICATION EXAMINATION RESULTS
SUCCESSFUL CANDIDATES

YEAR	JUNE EXAMINATION		OCTOBER EXAMINATION		TOTAL/YEAR	
	No.	% Pass	No.	% Pass	No.	% Pass
1979	839	92.6%	221	94.7%	1060	93.7%
1980	728	87.5%	218	96.0%	946	91.8%
1981	680	92.3%	198	84.6%	878	88.5%
1982	646	93.1%	192	94.6%	838	93.9%
1983	602	90.0%	196	95.6%	798	92.8%
1984	702	89.6%	206	94.2%	908	91.9%